SOIL SURVEY OF
Andrews County, Texas

ELECTRONIC VERSION

This soil survey is an electronic version of the original printed copy dated August 1974. It has been formatted for electronic delivery. Additional and updated information may be available from the Web Soil Survey. In Web Soil Survey, identify an Area of Interest (AOI) and navigate through the AOI Properties panel to learn what soil data is available.

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station

Issued August 1974

Major fieldwork for this soil survey was done in the period 1966-70. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Gaines-Andrews Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C., 20250.

HOW TO USE THIS SOIL SURVEY

This soil survey contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Andrews County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by series and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites and capability units.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Ranchers and others can find, under "Range Management," groupings of the soils according to their suitability for range, and the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Andrews County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover picture: Typical landscape view of range in Andrews County. Soils are Blakeney and Conger soils, gently undulating.

Contents

SOIL SURVEY OF ANDREWS COUNTY, TEXAS

BY NATHANIEL R. CONNER, HAROLD W. HYDE, AND HERBERT R. STONER,
SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE,
IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

Andrews County is in the extreme southern part of the High Plains area in Texas (fig. 1). Andrews County has a total area of 962,560 acres. Elevation ranges from 3,000 to 3,400 feet. The county consists of nearly level to undulating plains. The most common soils in the county are sandy, but the soils are loamy and clayey in some areas. Andrews County has a cool-temperate, dry steppe climate and mild winters. Average yearly rainfall is 13.89 inches.

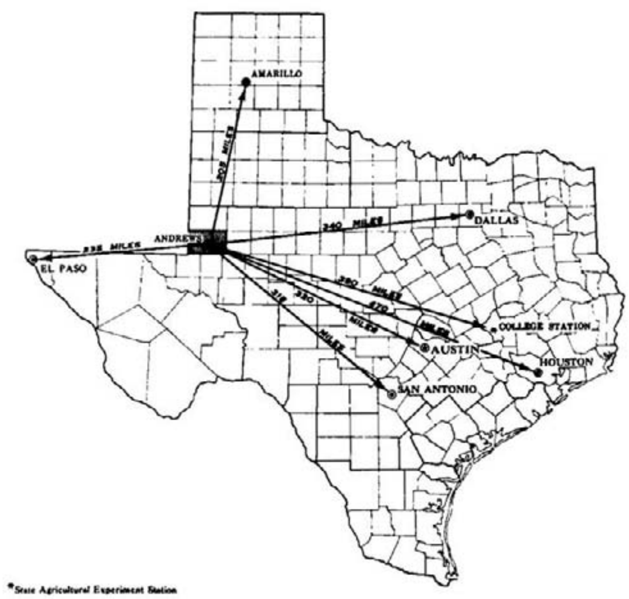


Figure 1.—Location of Andrews County in Texas.

In 1970, the county was dominantly range, and about 5 percent was used for crops such as cotton and grain sorghum. Cattle is the main type of livestock.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Andrews County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Faskin and Ratliff, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Triomas loamy fine sand, 0 to 3 percent slopes, is a phase within the Triomas series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful. in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil. map of Andrews County: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Kimbrough-Slaughter complex, 0 to 3 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one mapping unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Jalmar-Penwell association, undulating, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be, made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Blakeney and Conger soils, gently undulating, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot he classified by soil series. These

places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Dune land is a land type in Andrews County.

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, range managers, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Andrews County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large areas that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The seven soil associations in Andrews County are each described in the following pages. The terms for texture used in the title for several of the associations apply to the surface layer. For example, in the title for association 1, the words "fine sands" refer to texture of the surface layer.

Soil associations and delineations on the general soil map in this survey do not fully agree with those of the general soil maps in adjacent counties published at a different date. Differences in the maps are the result of improvements in the classification of soils, particularly in the modifications or refinements in soil series concepts.

1. Jalmar-Penwell association

Deep, moderately permeable to rapidly permeable fine sands

This association consists of nearly level to undulating soils on uplands. It occupies broad areas throughout the county.

This association makes up about 36 percent of the county (fig. 2). Jalmar soils make up about 56 percent of the association and Penwell soils about 41 percent. The remaining 3 percent consists mainly of Triomas and Wickett soils and Dune land.

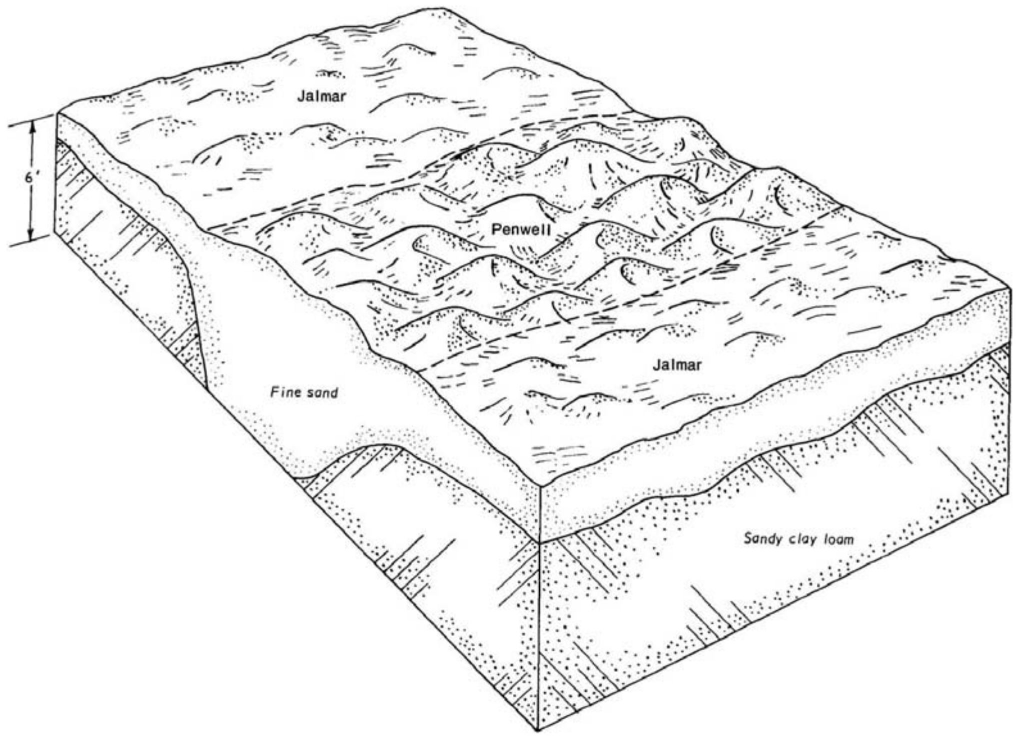


***Figure 2.*—Relationship of soils and underlying materials in the Jalmar-Penwell association.**

Jalmar soils are nearly level to gently undulating and occupy uplands. The surface layer is fine sand about 26 inches thick. It is brown in the upper part and reddish brown in the lower part. The next layer is red sandy clay loam in the upper 38 inches. Below this, to a depth of 80 inches, it is reddish-yellow sandy clay loam.

Penwell soils generally are undulating. The surface layer is pale-brown fine sand about 13 inches thick. The underlying material is fine sand that is very pale brown in the upper part and reddish yellow in the lower part. It extends to a depth of about 85 inches.

Most of this association is used for range. There is a severe hazard of soil blowing.

2. Triomas-Wickett association

Deep and moderately deep, moderately permeable to moderately rapidly permeable fine sands and loamy fine sands

This association consists of nearly level to gently undulating soils on uplands. It is in broad areas throughout the county.

This association occupies about 29 percent of the county. Triomas soils make up about 80 percent of the association and Wickett soils about 18 percent. The remaining 2 percent consists mainly of Douro, Faskin, Ima, and Jalmar soils (fig. 3).

Triomas soils have a surface layer of fine sand, about 16 inches thick, that is brown in the upper part and reddish brown in the lower part. The next layer is sandy clay loam to a depth of 80 inches. It is red in the upper part, light red in the middle part, and reddish yellow in the lower part.

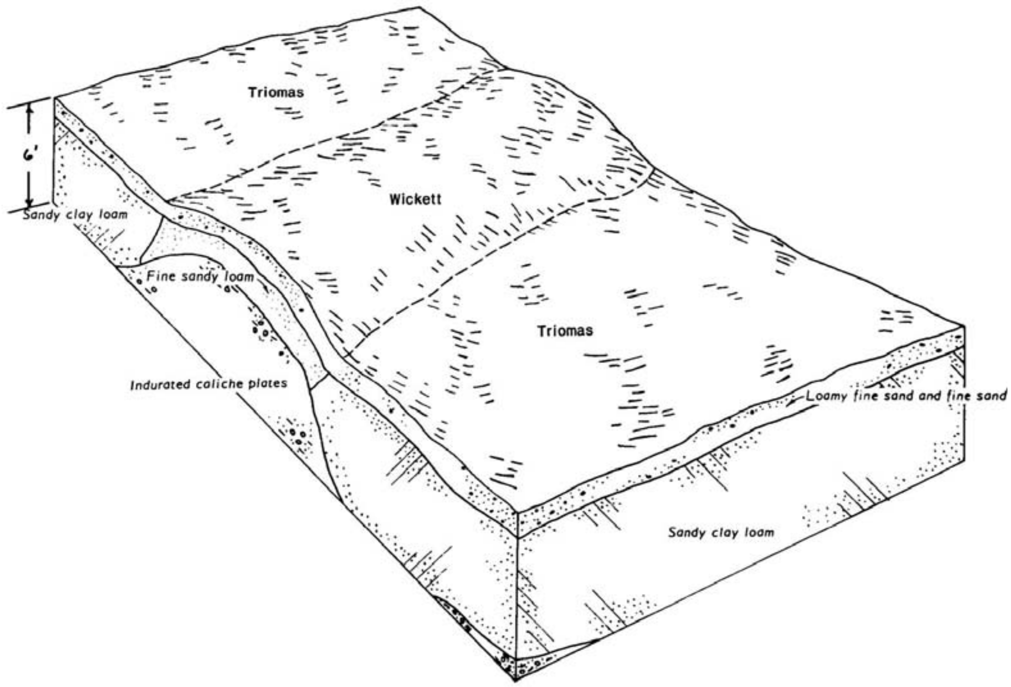


Figure 3.—Relationship of soils and underlying materials in the Triomas-Wickett association.

Wickett soils generally occupy the top part of upper slopes. The surface layer is a reddish-brown loamy fine sand about 16 inches thick. The next layer is yellowish-red fine sandy loam, about 17 inches thick, that is underlain by a layer of indurated platy caliche.

Most of this association is used for range, but some areas are farmed. There is a severe hazard of soil blowing.

3. Faskin-Douro association

Deep and moderately deep, moderately permeable fine sandy loams

This association consists of nearly level to gently undulating soils on uplands. It occupies broad areas throughout the county.

This association occupies about 16 percent of the county. Faskin soils make up about 70 percent of the association and Douro soils about 25 percent. The remaining 5 percent consists mainly of Blakeney, Conger, Lipan, Ratliff, Slaughter, Stegall, and Wickett soils.

Faskin soils have a surface layer of brown fine sandy loam about 8 inches thick. The next layer is sandy clay loam to a depth of 80 inches. It is reddish brown in the upper part, yellowish red and red in the middle part, and reddish yellow in the lower part.

Douro soils have a surface layer of reddish-brown fine sandy loam about 9 inches thick. The next layer is about 21 inches of sandy clay loam that is reddish brown in the upper part and red in the lower part. It is underlain by a layer of indurated caliche.

Most of this association is used for range. A few areas are cultivated to cotton and grain sorghum. The hazard of soil blowing is moderate.

4. Kimbrough-Slaughter-Stegall association

Very shallow to moderately deep, moderately permeable to moderately slowly permeable loams and clay loams

This association consists of nearly level to gently undulating soils on uplands. It is on mounds and ridges and in weakly concave areas.

This association occupies about 8 percent of the comity. Kimbrough soils make up about 80 percent of the association, Slaughter soils about 10 percent, and Stegall soils about 4 percent. The remaining 6 percent consists mainly of Blakeney, Conger, Douro, and Lipan soils.

Kimbrough soils are gently undulating and occupy mounds and ridges. The surface layer is dark-brown loam about 8 inches thick. It rests abruptly on a layer of indurated to strongly cemented caliche that extends to a depth of about 54 inches.

Slaughter soils are in nearly level, weakly concave areas. The surface layer is dark reddish-gray clay loam about 5 inches thick. The next layer is reddish-brown clay loam about 11 inches thick. It is underlain by indurated caliche plates.

Stegall soils also are in nearly level, weakly concave areas. The surface layer is grayish-brown clay loam about 5 inches thick. The next layer, about 24 inches thick, is clay loam that is dark grayish brown in the upper part and brown in the lower part. It is underlain by indurated caliche.

Most of this association is used for range. The hazard of soil blowing is slight to moderate.

5. Ratliff association

Deep, moderately permeable loams

This association consists of nearly level to gently undulating soils that are mostly on uplands. Some areas of the gently undulating soils are around the bottoms of enclosed depressions or intermittent lakes (playas), and some are around salt lakes.

This association occupies about 6 percent of the county. Ratliff soils make up about 85 percent of the association. The remaining 15 percent consists mainly of Blakeney, Conger, Faskin, Krade, Lipan, and Portales soils. Most of the areas occupied by salt lakes are also included in this association.

Ratliff soils are on uplands. They have a grayish-brown loam surface layer about 10 inches thick. The next layer is about 15 inches of light-brown clay loam, 42 inches of clay loam that is pink in the upper part and reddish yellow in the lower part, and 13 inches of pinkish-gray clay loam.

Most of this association is used for range; a few areas are cultivated. The hazard of soil blowing is moderate.

6. Blakeney-Conger association

Shallow, moderately rapidly permeable to moderately permeable fine sandy loams and loams

This association consists of nearly level to gently undulating soils that are on plains dissected by drainageways and on ridges around playas.

This association makes up about 3 percent of the county. Blakeney soils make up about 45 percent of the association and Conger soils about 40 percent. The remaining 15 percent consists mainly of Kimbrough, Lipan, and Potter soils.

Blakeney soils are gently undulating and generally occupy the slightly higher, more convex parts of the association. The surface, layer is brown fine sandy loam about 7 inches thick. The next layer is about 11 inches of brown fine sandy loam and is underlain by a layer of white, strongly cemented caliche.

Conger soils are less sloping and are in areas slightly below Blakeney soils. The surface layer is grayish-brown loam about 6 inches thick. The next layer is pale-brown clay loam about 11 inches thick. It is underlain by a layer of white caliche plates that are strongly to weakly cemented.

This association is used primarily for range. The hazard of soil blowing is moderate.

7. Ima-Potter-Portales association

Deep to very shallow, moderately rapidly permeable to moderately permeable loamy fine sands, loams, and clay loams

This association consists of nearly level to sloping soils that occupy the sides and bottoms of draws.

This association occupies about 2 percent of the county. Ima soils make up about 50 percent of the association, Potter soils, about 6 percent, and Portales soils, about 4 percent. The remaining 40 percent consists mainly of Blakeney, Jalmar, Kimbrough, Ratliff, and Triomas soils.

Ima soils are on the sides of draws. The surface layer is light yellowish-brown loamy fine sand about 14 inches thick. The next layer is yellowish-brown fine sandy loam to a depth of 36 inches. Below this, very pale brown fine sandy loam to sandy clay loam extends to a depth of 84 inches.

Potter soils generally are in the higher areas above the Ima soils. The surface layer is brown loam about 5 inches thick. This layer rests abruptly on a layer of platy caliche.

Portales soils occupy the bottoms of draws. The surface layer is grayish-brown clay loam about 15 inches thick. The next layer, clay loam about 32 inches thick, is brown in the upper part and pale brown in the lower part. The underlying material, to a depth of about 88 inches, is white clay loam.

Most of this association is used for range. A few areas are cultivated. The hazard of soil blowing is slight to severe.

Descriptions of the Soils

This section describes each of the soil series and the mapping units in Andrews County. The procedure is first to describe a soil series and then the mapping units in that series. Thus, to get full information on any given mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils.

One mapping unit, Dune land, is a land type and does not belong to a soil series. Nevertheless, it is listed in alphabetic order with the soil series.

In describing the representative profile, the color of each horizon is given by name and by the Munsell color notation, which measures hue, value, and chroma. For the profile described, the names of the colors and the color symbols are for dry soils, unless otherwise stated.

Following the name of each mapping unit is the symbol, in parentheses, that identifies the soil or land type on the detailed map at the back of the survey. Shown at the end of each mapping unit description are the capability classification and the range site in which the mapping unit has been placed. The page on which each mapping unit and range site is described is listed in the "Guide to Mapping Units."

Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the, terminology and methods of soil mapping can be obtained from the Soil Survey Manual *(5)*.

Blakeney Series

The Blakeney series consists of nearly level to gently undulating soils that are shallow over caliche. These soils formed in friable, calcareous, loamy sediments on uplands.

In a representative profile, the upper 18 inches is brown fine sandy loam that rests abruptly on a layer of strongly cemented caliche about 14 inches thick. Below this, to a depth of about 68 inches, is weakly cemented caliche.

These soils are well drained. Internal drainage is medium; permeability is moderately rapid. The hazards of soil blowing and water erosion are moderate.

In Andrews County, Blakeney soils are mapped only in an undifferentiated unit with the Conger soils.

Representative profile of a Blakeney fine sandy loam in an area of Blakeney and Conger soils, gently undulating (50 feet north of a point on Texas Highway 176 that is 15 miles northwest of Andrews County courthouse):

A1—0 to 7 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) when moist; weak, medium, subangular blocky structure; slightly hard, friable; common very fine and fine roots and pores; common caliche fragments 5 to 10 millimeters in diameter; calcareous; moderately alkaline; gradual, smooth boundary.

B—7 to 18 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) when moist; weak, coarse, prismatic structure parting to weak subangular blocky; slightly hard, friable; common very fine roots; common medium caliche fragments; calcareous; moderately alkaline; abrupt, wavy boundary.

C1cam—18 to 32 inches, white (10YR 8/2), strongly cemented, rounded caliche plates that are 2 to 4 inches in diameter; abrupt, wavy boundary.

C2ca—32 to 68 inches, pinkish-white (7.5YR 8/2) weakly cemented caliche that is about 25 percent, by volume, powdery masses of calcium carbonate; massive.

The A horizon ranges from 5 to 10 inches in thickness and is brown or light brown. The B horizon is 7 to 14 inches thick and is brown or pale brown. The C1cam horizon begins at a depth or 12 to 20 inches. The caliche plates range from 2 to 8 inches in diameter and from 1 to 3 inches in thickness.

Blakeney and Conger soils, gently undulating

(BCB).—These soils are along drainageways and around playas. Slopes range from 0 to 3 percent. Areas are irregular and range from 30 to several hundred acres in size. These soils have a profile described as representative for the Blakeney and Conger series.

Blakeney soils make up about 49 percent of the total acreage, and Conger soils, 47 percent. The remaining 4 percent is mainly Kimbrough and Potter soils. Some of the areas consist of either Blakeney or Conger soils. These soils do not occur in regular patterns, but it is not feasible to map them separately because their use and management are similar.

The hazard of soil blowing is moderate. Good management of these soils requires the return of large amounts of crop residue. Most of the acreage is used for range. These soils are better suited to irrigated farming than to dryland farming. A few areas are used for cotton and grain sorghum. Capability units VIe-2, dryland, and IIIe-6, irrigated; Mixed Plains range site.

Conger Series

The Conger series consists of nearly level to gently undulating soils that are shallow over caliche. These soils formed in friable, calcareous, loamy sediments on uplands.

In a representative profile, the surface layer is grayish-brown loam about 6 inches thick. The next layer is friable, pale-brown clay loam about 11 inches thick. It rests abruptly on a layer of white caliche plates about 22 inches thick. Below this, to a depth of about 75 inches, is weakly cemented caliche.

These soils are well drained. Internal drainage is medium; permeability is moderate. The hazards of soil blowing and water erosion are moderate.

In Andrews County, Conger soils are mapped only in an undifferentiated unit with the Blakeney soils.

Representative profile of a Conger loam in an area of Blakeney and Conger soils, gently undulating (200 feet north of a point on Texas Highway 176 that is 29 miles northwest of Andrews County courthouse):

A1—0 to 6 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, subangular blocky structure; slightly hard, friable, sticky; common very fine and fine roots and pores; light brownish-gray (10YR 6/2), thin, platy surface crust about 1/4 inch thick; about 2 percent, by volume, is weakly to strongly cemented caliche fragments less than 10 millimeters in diameter; calcareous; moderately alkaline; clear, smooth boundary.

B—6 to 17 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable, sticky; common very fine roots and pores; 5 to 10 percent, by volume, is medium caliche fragments less than 10 millimeters in diameter; calcareous; moderately alkaline; abrupt, wavy boundary.

C1cam—17 to 39 inches, white (10YR 8/2) caliche plates that are laminar and strongly cemented in the uppermost 1/2 inch; abrupt, wavy boundary.

C2ca—39 to 75 inches, white (10YR 8/2), weakly cemented caliche material that is about 50 percent, by volume, of visible calcium carbonate; massive.

The A horizon ranges from 4 to 6 inches in thickness and is grayish brown or brown. The B horizon ranges in thickness from 8 to 15 inches, and it is light brownish gray or pale brown. The C1cam horizon begins at a depth of 12 to 20 inches. The caliche plates range from 4 to 8 inches in diameter and from 1 to 3 inches in thickness. The laminar upper layer of the plates ranges from 1/2 inch to 2 inches in thickness.

Douro Series

The Douro series consists of nearly level to gently undulating soils that are moderately deep over caliche. These soils formed in friable, loamy sediments over indurated caliche on uplands.

In a representative profile (fig. 4), the surface layer is reddish-brown fine sandy loam about 9 inches thick. The next layer is friable sandy clay loam about 21 inches thick. This layer is reddish brown in the upper part and red in the lower part. It rests abruptly on a layer of indurated caliche.

These soils are well drained. Internal drainage is medium; permeability is moderate. The hazard of soil blowing is moderate and the hazard of water erosion is slight.

Figure **4.—Profile of Douro fine sandy loam.**

In Andrews County, Douro soils are only mapped in an undifferentiated unit with Faskin soils.

Representative profile of a Douro fine sandy loam in an area of Faskin and Douro soils, gently undulating (9 miles east of Andrews County courthouse, then 11.8 miles south of the intersection of State Highway 176 and Farm Road 1788, then 2.9 miles west on paved county road, then 0.2 mile north and 0.15 mile west, then 100 feet north of oilfield road):

A1—0 to 9 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, fine, granular and weak, fine and medium, subangular blocky structure; slightly hard, friable, nonsticky; common very fine roots and pores; neutral; gradual, smooth boundary.

B21t—9 to 21 inches, reddish-brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) when moist; crushed color, dark red (2.5YR 3/6) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm, slightly sticky; common roots, few fine pores; few thin clay films on faces of prisms; neutral; gradual, smooth boundary.

B22t—21 to 30 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm, slightly sticky; few very fine pores; few thin clay films; mildly alkaline; abrupt, wavy boundary.

C1cam—30 to 51 inches, platy indurated caliche; laminar in the upper 1/2 inch, strongly cemented in lower part; clear, wavy boundary.

C2ca—51 to 75 inches, weakly cemented caliche; more than 50 percent, by volume, of visible calcium carbonate; massive.

The A horizon ranges from 7 to 12 inches in thickness and is reddish brown or brown. Reaction is neutral or mildly alkaline. The B2t horizon ranges from 13 to 28 inches in thickness and is reddish brown to yellowish red or red. Reaction is neutral or mildly alkaline. The C1cam horizon begins at a depth of 20 to 40 inches below the surface. The caliche plates range from 2 to 8 inches in diameter and from 1/2 inch to 8 inches in thickness. The laminar upper part of the caliche ranges from 1/2 inch to 3 inches in thickness.

Dune Land

Dune land (DU) is a miscellaneous land type consisting of barren active sand dunes (fig. 5). These dunes range from 25 to 200 feet in height and from 50 to 300 acres in size, and they have slopes of 3 to 20 percent. They consist of eolian sand and have no horizon development. Dunes occur in association with Jalmar and Penwell soils.

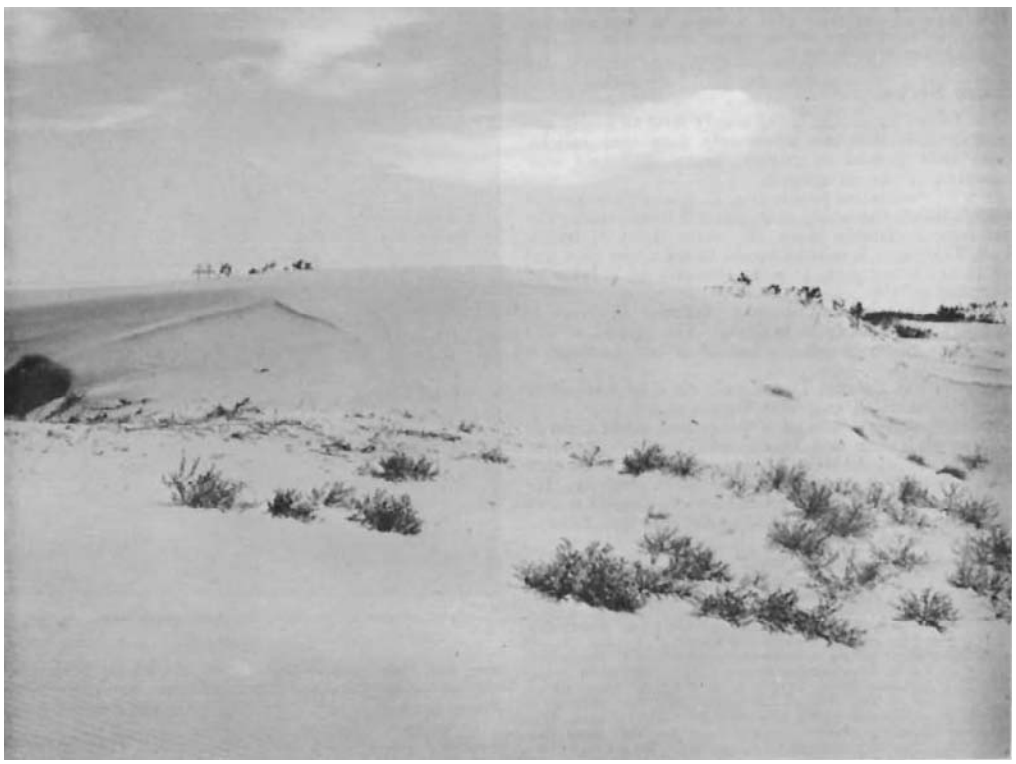


***Figure* 5.—Dune land showing severe effects of soil blowing.**

Dunes have a low available water capacity and are excessively drained and rapidly permeable. They are constantly shifted by wind and are more unstable on the east and north sides. They have no vegetation except on the outer edges, where shinnery and giant dropseed grow.

These areas have little value except for wildlife and should be protected from grazing by livestock. Capability unit VIIIe, dryland; not placed in a range site.

Faskin Series

The Faskin series consists of deep, nearly level to gently undulating soils. These soils formed in friable, loamy sediments of outwash and eolian material on uplands.

In a representative profile, the surface layer is brown fine sandy loam about 8 inches thick. The next layer is friable sandy clay loam to a depth of 80 inches. It is reddish brown in the upper part, yellowish red to red in the middle part, and reddish yellow in the lower part.

These soils are well drained. Internal drainage is medium; permeability is moderate. The hazard of soil blowing is moderate, and the hazard of water erosion is slight.

In Andrews County, the Faskin soils are mapped only in an undifferentiated unit with the Douro soils.

Representative profile of a Faskin fine sandy loam in an area of Faskin and Douro soils, gently undulating (9 miles east of the Andrews County courthouse, then 13.1 miles south of the intersection of State Highway 176 and Farm Road 1788, then 0.6 mile west of Farm Road 1788):

A1—0 to 8 inches, brown (7.5YR 4/4) fine sandy loam, dark brown (7.5YR 3/4) when moist; weak, fine, granular and subangular blocky structure; hard, friable, nonsticky; common very fine roots and pores and few fine roots; neutral; clear, smooth boundary.

B21t—8 to 20 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, friable, slightly sticky; common very line roots; few thin clay films on faces of pods and prisms; sand grains coated and bridged with clay; neutral; clear, smooth boundary.

B22t—20 to 34 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; very hard, friable, slightly sticky; few very fine to fine roots; nearly continuous clay films on faces of prisms and few thin clay films on faces of peds; mildly alkaline; clear, smooth boundary.

B23t—34 to 42 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable, slightly sticky; common very fine pores; nearly continuous clay films on faces of prisms and few thin clay films on faces of peds; noncalcareous; moderately alkaline; gradual, wavy boundary.

B24tca—42 to 66 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable, slightly sticky; common thin clay films on pods; 10 percent, by volume, is soft masses of calcium carbonate, mainly coating on faces of peds; calcareous; moderately alkaline; gradual, wavy boundary.

B25t—66 to 80 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable, slightly sticky; few discontinuous clay films on faces of peds; many films and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 7 to 12 inches in thickness and is brown or reddish brown. The Bt horizon above the Btca horizon ranges from 29 to 50 inches in thickness. It is reddish brown, yellowish red, or red. Films and threads of secondary carbonates are within 32 to 50 inches of the surface. Reaction is neutral to moderately alkaline.

The Btca horizon begins at a depth of 36 to 53 inches and is red or reddish yellow. Soft masses of calcium carbonate comprise 10 to 50 percent, by volume, of

this horizon. The Bt horizon below the Btca horizon is light reddish brown or reddish yellow. Films and threads of calcium carbonate comprise 5 to 15 percent, by volume, of this horizon.

Faskin and Douro soils, gently undulating (FDB).—These soils occupy the broad uplands. They are in irregular and oval-shaped areas that range from 30 to several hundred acres in size. Slopes are convex and range from 0.5 to 3 percent. These soils have the profiles described as representative for the Faskin and Douro series.

Faskin soils make up about 63 percent of the total acreage, and Douro soils, about 21 percent. The remaining 16 percent is mainly Blakeney, Lipan, Slaughter, and Stegall soils and other soils that are similar to Douro soils but are less than 20 inches thick over indurated caliche. All of these soils occur in irregular patterns, and it is not feasible to map them separately because their use and management are similar.

The hazard of soil blowing is moderate. Large amounts of fertilized crop residue need to be kept on the surface to maintain soil tilth and control soil blowing and water erosion. Most of the acreage is used for range, but a few areas are used for cotton and grain sorghum. Capability units IVe-1, dryland, and IIIe-3, irrigated; Sandy Loam range site.

Ima Series

The Ima series consists of deep, nearly level to gently sloping soils. These soils formed in friable, sandy, calcareous sediments on uplands.

In a representative profile, the surface layer is light yellowish-brown loamy fine sand about 14 inches thick. The next layer is yellowish-brown, friable fine sandy loam in the upper 22 inches and very pale brown fine sandy loam to sandy clay loam in the lower 19 inches. The underlying material, to a depth of 84 inches, is very pale brown sandy clay loam.

These soils are well drained. Internal drainage is rapid; permeability is moderately rapid in the upper 44 inches and moderate below. The hazard of soil blowing is severe, and the hazard of water erosion is slight.

Representative profile of Ima loamy fine sand, 0 to 3 percent slopes (9.7 miles north of Andrews County courthouse on U.S. Highway 385, then 2 miles east on Florey Road, then 0.2 mile south and 528 feet east):

A1—0 to 14 inches, light yellowish-brown (10YR 6/4) loamy fine sand, dark yellowish brown (10YR 4/4) when moist; weak, fine, granular and subangular blocky structure; soft, very friable, nonsticky; common very fine roots; mildly alkaline; clear, smooth boundary.

B21—14 to 36 inches, yellowish-brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) when moist; weak, coarse, prismatic structure parting to weak, subangular blocky; slightly hard, friable, slightly sticky; few films, threads, and fragments of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

B22ca—36 to 44 inches, very pale brown (10YR 8/4) fine sandy loam, very pale brown (10YR 7/4) when moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky; 10 percent, by volume, is visible soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—44 to 55 inches, very pale brown (10YR 7/4) sandy clay loam, light yellowish brown (10YR 6/4) when moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky; 5 percent, by volume, is visible calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C—55 to 84 inches, very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) when moist; massive; soft, friable, slightly sticky; 5 percent, by volume, is visible calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 10 inches to 14 inches in thickness and is brown, light yellowish brown, or light brown. The B2 horizon above the Bca horizon ranges from 15 to 36 inches in thickness and is pale brown, yellowish brown, or light brown. The Bca horizon begins at a depth of 29 to 48 inches and is reddish yellow or very pale brown.

Ima loamy fine sand, 0 to 3 percent slopes (ImB).—This nearly level to gently sloping soil occurs on uplands. Its areas are irregular and range from 30 to 100 acres in size. Included in mapping are small areas of Blakeney, Jalmar, and Triomas soils.

The hazard of soil blowing is severe. Large amounts of crop residue need to be kept on the surface to help control soil blowing and water erosion and to help maintain soil tilth. Most of the acreage is used for range. This soil is not suited to dryland farming, but it is suited to irrigated farming. A few areas are used for cotton and grain sorghum. Capability units VIe-5, dryland, and IIIe-5, irrigated; Sandyland range site.

Jalmar Series

The Jalmar series consists of deep, nearly level to undulating soils. These soils formed in friable, eolian, sandy material on uplands.

In a representative profile, the surface layer is fine sand about 26 inches thick. It is brown in the upper part and reddish brown in the lower part. The next layer is sandy clay loam to a depth of 80 inches. This layer is red in the upper 38 inches and reddish yellow below.

These soils are well drained. Internal drainage is medium; permeability is moderate. The hazard of soil blowing is severe, and the hazard of water erosion is slight.

In Andrews County, Jalmar soils are mapped only in an association with Penwell soils.

Representative profile of a Jalmar fine sand in an area of Jalmar-Penwell association, undulating (9.7 miles north of the Andrews County courthouse on U.S. Highway 385, then 1.8 miles east on Florey Road, then 0.8 mile north on oilfield road and 75 feet east):

A11—0 to 14 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; single grain; loose, nonsticky; common fine roots; neutral; gradual, smooth boundary.

A12—14 to 26 inches, reddish-brown (5YR 5/4) fine sand, reddish brown (5YR 4/4) when moist; single grain; loose, nonsticky; common fine roots; neutral; clear, smooth boundary.

B21t—26 to 52 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, firm, slightly sticky; few fine roots and pores; few thin clay films on ped faces; neutral; gradual, wavy boundary.

B22t—52 to 64 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable, slightly sticky; common distinct clay films on prism faces; neutral; gradual, wavy boundary.

B23tca—64 to 80 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable, slightly

sticky; few thin clay films on ped faces; about 25 percent, by volume, is visible calcium carbonate in soft masses and coatings on peds; calcareous; moderately alkaline.

The A horizon ranges from 22 to 39 inches in thickness and is reddish brown or brown. The Bt horizon above the Btca horizon ranges from 28 to 48 inches in thickness. It is light red, red, or yellowish red. Reaction is neutral or mildly alkaline. A Btca horizon occurs between 50 and 70 inches below the surface.

Jalmar-Penwell association, undulating (JPC).—Areas of these soils range from 600 to 3,000 acres in size. Slopes are convex and range from 0.5 to 8 percent. These soils have the profiles described as representative for the Jalmar and Penwell series.

Jalmar soils make up about 56 percent of the total acreage, and Penwell soils, about 40 percent. The remaining 4 percent is mainly Triomas soils, unstabilized Dune land, and a soil that is similar to Jalmar soils but has a fine sand surface layer more than 40 inches thick. Soils in this association occur together in regular patterns, but they are not mapped separately because their use and management are similar.

The hazard of soil blowing is severe. Large amounts of crop residue need to be kept on the surface to help control soil blowing. Most of the acreage is used for range, but a few areas are used for cotton and grain sorghum. These soils are not suited to dryland farming. Capability units VIe-3, dryland, and IVe-2, irrigated, for Jalmar soils; and VIIe-1, dryland, for Penwell soils; Deep Sand range site.

Kimbrough Series

The Kimbrough series consists of gently undulating soils that are very shallow to shallow over caliche. These soils formed in friable, loamy sediments over indurated caliche on uplands.

In a representative profile, the surface layer is dark-brown loam about 8 inches thick. It rests abruptly on a layer of indurated plates of caliche about 23 inches thick. Below this, to a depth of about 54 inches, are strongly cemented caliche plates (fig. 6).

Kimbrough soils are well drained. Internal drainage is medium; permeability is moderate. The hazards of soil blowing and water erosion are slight.

Representative profile of a Kimbrough loam in an area of Kimbrough soils, gently undulating (9 miles east of the Andrews County courthouse, then 11.8 miles south of the intersection of State Highway 176 and Farm Road 1788, then 1.4 miles west on county road, 0.2 mile north):

A1—0 to 8 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky; common very fine to fine roots and pores; 2 percent medium to coarse fragments of calcium carbonate in lower part; mildly alkaline; abrupt, wavy boundary.

C1cam—8 to 31 inches, indurated plates of caliche that are laminar in the upper 1/2 inch; few plates are fractured; abrupt, wavy boundary.

C2ca—31 to 54 inches, strongly cemented plates of caliche coated with calcium carbonate; plates range from 7 to 15 inches along the long axis.

The A horizon ranges from 4 to 10 inches in thickness and is brown or dark brown. Coarse fragments cover 2 to 15 percent of the surface area. Reaction is neutral or moderately alkaline. Texture is mainly loam but may be clay loam. The C1cam horizon begins at a depth of 4 to 10 inches and ranges from 20 to 26 or more inches in thickness. The caliche plates range from 6 to 12 inches in diameter and are laminar in the upper 1/2 inch to 2 inches. The plates in this horizon range from strongly cemented to indurated.

***Figure 6.*—Profile of a Kimbrough soil.**

Kimbrough soils, gently undulating (KMB).—Areas of these soils are irregular and range from 40 to 400 acres in size. Slopes are weakly convex to slightly concave and range from 0 to 3 percent. One of these soils has the profile described as representative for the Kimbrough series, but in places the surface layer is clay loam rather than loam.

Included in mapping are small areas of Conger, Lipan, and Slaughter soils.

Most of the acreage is used for range, recreational areas, and wildlife habitat. Capability unit VIIs-1, dry-land; Very Shallow range site.

Kimbrough-Slaughter complex, 0 to 3 percent slopes (KsB).—These nearly level to gently sloping soils occur in such intricate patterns that it is not practical to map them separately. Kimbrough soils are gently sloping and are on mounds and ridges. Slaughter soils are nearly level to weakly concave and are in circular areas a few inches below the Kimbrough soils. Areas of the complex range from 110 acres to 3,500 acres in size.

Kimbrough soils have a brown loam surface layer that is about 5 inches thick over indurated caliche. Slaughter soils have a reddish-brown clay loam surface layer that is about 16 inches thick over indurated caliche.

Kimbrough soils make up about 48 percent of the total acreage, and Slaughter soils, about 32 percent. The remaining 20 percent is mainly Conger, Blakeney, Lipan, and Stegall soils.

This complex is not suited to crops because of the shallow depth of the Kimbrough soils. It is best suited to range, recreational areas, or wildlife habitat. Capability unit VIIs-1; dryland; Very Shallow range site.

Krade Series

The Krade series consists of deep, undulating soils on uplands. They formed in friable, loamy sediments high in content of lime.

In a representative profile, the surface layer is brown fine sandy loam about 7 inches thick. The next layer is fine sandy loam to a depth of about 80 inches. The

upper 22 inches of this layer is brown, and the lower part is pink and contains a few films and threads of calcium carbonate.

These soils are well drained. Internal drainage is medium; permeability is moderately rapid. The hazards of soil blowing and water erosion are severe (fig. 7).

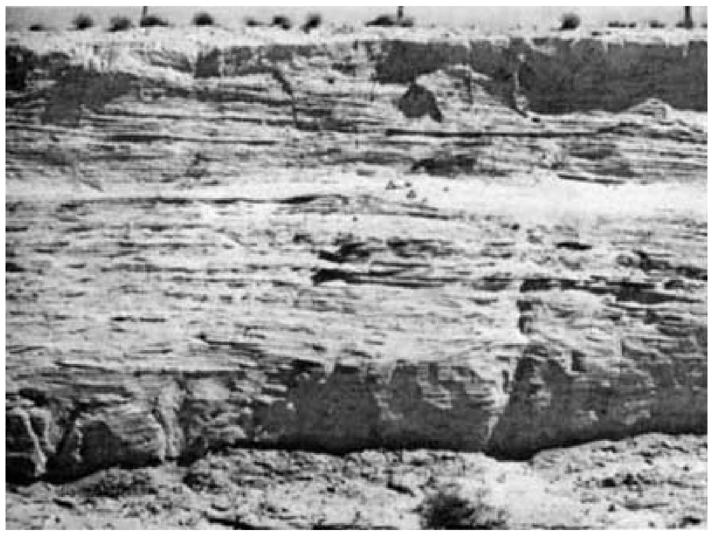


Figure 7.—**An area of Krade soils. This roadside cut shows a layer of wind-deposited material.**

Representative profile of a Krade fine sandy loam in an area of Krade soils, undulating (8 miles north of Andrews County courthouse, then 3.9 miles west, of intersection of U.S. Highway 385 and Farm Road 1967, then 0.7 mile south on oilfield road and 100 feet west):

A1—0 to *7* inches, brown (10YR 5/3*)* fine sandy loam, brown (10YR 4/3) when moist; weak, line, subangular blocky structure; soft, very friable; common very fine roots and pores; calcareous; moderately alkaline; clear, smooth boundary.

C1—7 to 29 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) when moist; massive; soft, friable; few roots; common very fine pores; calcareous; moderately alkaline; gradual, smooth boundary.

C2—29 to 80 inches, pink (7.5YR 7/4) fine sandy loam, light brown (7.5YR 6/4) when moist; slightly hard, friable; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness and is brown, grayish brown, or dark grayish brown. Its texture is mainly fine sandy loam but ranges to loam or loamy sand. The C1 horizon ranges from 11 to 23 inches in thickness and is light brown, light gray, or very pale brown.

Krade soils, undulating (KRC).—These soils occupy upland areas around salt lakes and playas. Areas are irregular in shape and range from 100 to 300 acres in size but generally are about 200 acres. Slopes range from 1 to 5 percent. Texture of the surface layer is mainly fine sandy loam but ranges to loam and loamy sand.

Included in mapping are small areas of Ratliff soils. Also included is a soil that is underlain by gypsum within 10 to 20 inches of the surface. This included soil makes up about 10 percent of the total area. In the vicinity of some salt lakes, small areas of underlying red beds are exposed.

Most of the acreage is used for range, recreational areas, and wildlife habitat. Capability unit VIe-4, dry-land; High Lime range site.

Lipan Series

The Lipan series consists of deep, nearly level soils that occupy the bottoms of enclosed depressions of intermittent lakes (playas). These soils formed in clayey, calcareous sediments.

In a representative profile, the surface layer is very firm gray clay about 16 inches thick. The next layer is firm, light brownish-gray clay about 34 inches thick. This layer is underlain by a firm layer of light-gray clay to a depth of about 60 inches (fig. 8).

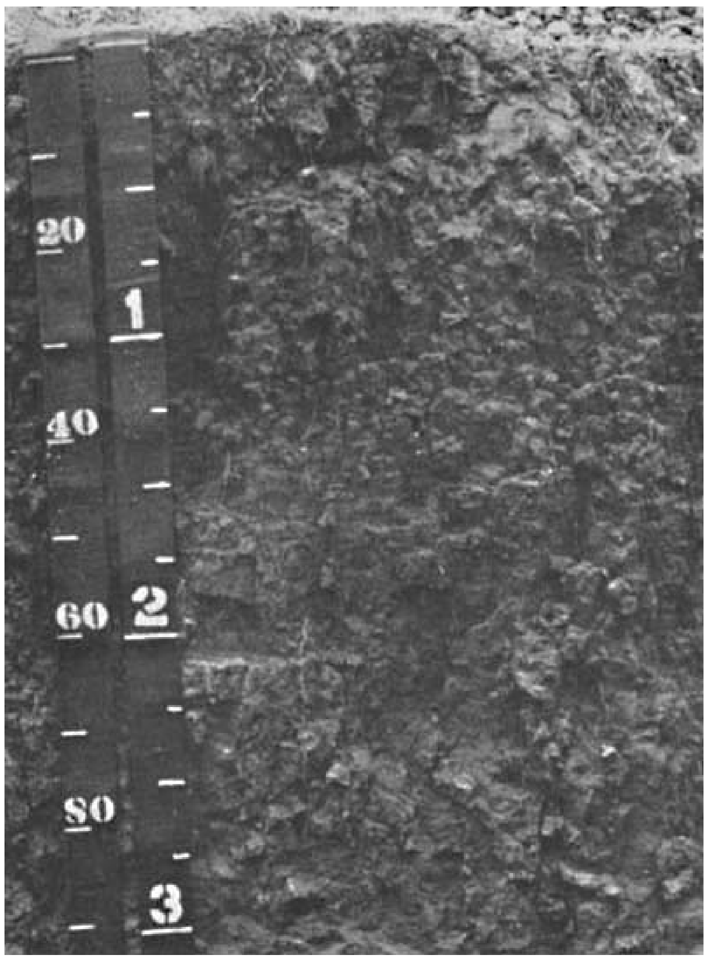


Figure 8.—Profile of Lipan clay.

These soils are moderately well drained. Internal drainage and permeability are very slow. The hazards of soil blowing and water erosion are slight.

Representative profile of Lipan clay (30 feet west of a point on Farm Road 1788 that is 15.4 miles south of intersection of Farm Road 1788 and Texas Highway 176, 9 miles east of Andrews County courthouse):

A11—0 to 4 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; moderate, medium and fine, blocky structure; very hard, very firm, sticky;

many fine roots; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

A12—4 to 16 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; moderate, medium and coarse, blocky structure; extremely hard, very firm, sticky; few fine roots; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

AC—16 to 50 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) when moist; few intersecting slickensides and parallelepipeds; medium and coarse blocky structure; extremely hard, firm, sticky; few very fine roots; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

Cca—50 to 60 inches, light-gray (10YR 7/2) clay, light brownish gray (10YR 6/2) when moist; massive; hard, firm, sticky; 12 percent, by volume, is very fine masses and threads of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 13 to 20 inches in thickness. This horizon is noncalcareous to calcareous and is mildly alkaline or moderately alkaline. The AC horizon ranges from 30 to 40 inches in thickness and is light brownish gray or dark grayish brown. The Cca horizon begins at a depth of 43 to 60 inches. This horizon is 5 to 15 percent calcium carbonate, by volume.

Lipan clay (Lc).—This soil occupies weakly concave playas. These depressions are rounded or oval shaped and range from 10 to 50 acres or more in size. Slopes are 0 to 1 percent.

Included in mapping are small areas of Ratliff and Portales soils on the outer edge of the depressions.

This soil is periodically inundated by excess water from adjacent soils. It swells when wet and cracks when dry and is not suited to cultivation unless drained. It is better suited to range and wildlife habitat. Capability unit VIw–1; included in surrounding range, site.

Penwell Series

The Penwell series consists of deep, undulating soils on uplands. These soils formed in loose, neutral, sandy eolian sediments. Slopes range from 1 to 8 percent.

In a representative profile, the surface layer is pale-brown fine sand about 13 inches thick. The next layer is loose fine sand to a depth of about 85 inches. It is very pale brown in the upper part; and reddish yellow in the lower part.

These soils are well drained. Internal drainage and permeability are rapid. The hazard of soil blowing is severe, and the hazard of water erosion is slight.

In Andrews County, Penwell soils are mapped only in an association with Jalmar soils.

Representative profile of a Penwell fine sand in an area of Jalmar-Penwell association, undulating (15 miles southwest of the Andrews County courthouse, then 3.7 miles south of the intersection of Farm Road 181 and State Highway 115, then 0.2 mile west):

A1—0 to 13 inches, pale-brown (10YR 6/3) line sand, brown (10YR 5/3) when moist; single grain; loose; few roots; neutral; gradual, smooth boundary.

C1—13 to 60 inches, very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) when moist; single grain; loose; few roots; neutral; gradual, smooth boundary.

C2—60 to 85 inches, reddish-yellow (7.5YR 7/6) fine sand, reddish yellow (7.5YR 6/6) when moist; single grain; loose; neutral.

The A horizon ranges from 8 to 15 inches in thickness and is pale brown or yellowish brown. The C horizon is 50 inches or more thick; it is very pale brown or reddish yellow.

Portales Series

The Portales series consists of deep, nearly level soils. These soils formed in friable, loamy, calcareous sediments.

In a representative profile, the surface layer is grayish-brown clay loam about 15 inches thick. The next layer is friable clay loam, about 32 inches thick, that is brown in the upper part and pale brown in the lower part. The underlying material, to a depth of about 88 inches, is white clay loam.

These soils are well drained. Internal drainage is medium; permeability is moderate. The hazards of soil blowing and water erosion are slight.

Representative profile of Portales clay loam (9 miles east of Andrews County courthouse, then 11.8 miles south of the intersection of. Farm Road 1788 and State Highway 176, then 2.9 miles east on county road, then 1.9 miles north on oilfield road and 0.2 mile west):

A1—0 to 15 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine and medium, granular and weak, fine, subangular blocky structure; hard, friable, slightly sticky; common fine and few medium roots and pores; calcareous; moderately alkaline; gradual, smooth boundary.

B2—15 to 36 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky; few fine roots; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—36 to 47 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky; estimated 10 percent, by volume, is fine concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

Cca—47 to 88 inches, white (10YR 8/2) clay loam, light gray (10YR 7/2) when moist; massive; about 40 percent, by volume, calcium carbonate concretions; few fine gypsum crystals, snail shells, and brownish-yellow mottles in lower part.

The A horizon ranges from 10 to 17 inches in thickness and is grayish brown or dark grayish brown. The B2 horizon ranges from 10 to 25 inches in thickness and is brown or pale brown. The B3ca horizon ranges from 5 to 20 inches in thickness and is light brown or pale brown. Five to 10 percent, by volume, of this horizon is calcium carbonate. The Cca horizon begins at a depth of 40 to 47 inches. It is white or very pale brown. This horizon is 30 to 50 percent, by volume, calcium carbonate.

Portales clay loam (Po).—This soil occupies flood plains of intermittent streams and draws. Its areas are narrow and several miles long. Slopes are 0 to 1 percent.

Included in mapping are areas of Ratliff soils. Also included are areas of a soil that is similar to this Portales soil except that the grayish-brown surface layer ranges up to 30 inches in thickness.

This Portales soil receives excess runoff water from surrounding areas and is occasionally subject to flooding. The hazard of soil blowing is slight. Most of the acreage is used for range, although the soil is suitable for cultivation if protected from flooding. Large amounts of fertilized crop residue need to be kept on the surface to maintain soil tilth and control soil blowing and water erosion. Capability units IVe-2, dryland, and IIe-2, irrigated; Valley range site.

Potter Series

The Potter series consists of sloping soils that are very shallow over caliche. These soils formed in loamy, calcareous sediments over caliche on uplands.

In a representative profile, the surface layer is brown loam about 5 inches thick. It rests abruptly on a layer of white platy caliche about 5 inches thick. Below this, to a depth of about 36 inches, is a mixture of white, slightly platy caliche and pinkish earth.

Potter soils are well drained. Internal drainage is slow to medium; permeability is moderate. The hazard of soil blowing is slight, and the hazard of water erosion is moderate (fig. 9).

***Figure* 9.—An area of Potter soils, sloping, and Portales clay loam in the bottom.**

Representative profile of a Potter loam in an area of Potter soils, sloping (14.6 miles northeast of the Andrews County courthouse, then 0.6 mile northwest of State Highway 115 and 175 feet northeast):

A1—0 to 5 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak, tine, subangular blocky structure; soft, friable, slightly sticky; common very fine roots and pores; many fragments of calcium carbonate 5 to 20 millimeters in diameter; calcareous; moderately alkaline; abrupt, wavy boundary.

Cca—5 to 10 inches, white (10YR 8/2) platy caliche; plates are 1 to 2 inches thick and have a hardness of less than 3 on Mohs' scale; plates are fractured in places, allowing some roots to penetrate; roots adhere to surface and bottom of plates; plates are 3 to 7 inches in diameter.

C2ca—10 to 36 inches, white (10YR 8/2) slightly platy caliche; plates are 1 to 2 inches in length; pinkish earth is between layers of caliche; estimated 30 to 40 percent, by volume, is weakly cemented caliche; more nearly massive than C1ca horizon.

The A horizon ranges from 4 to 10 inches in thickness and is light brown, brown, or pale brown. Texture is mainly loam but some areas are gravelly loam. Coarse fragments are on 10 to 15 percent of the surface. The Cca horizon begins at a depth of 4 to 10 inches. This horizon is weakly to strongly cemented.

Potter soils, sloping (PTC).—These soils are on the sides of Mustang and Seminole Draws. They occupy irregular, long areas that range from 15 to 100 acres in size. Slopes are convex and range from 5 to 8 percent. The surface layer is mainly loam but, in some areas, is gravelly loam.

Included in mapping are small areas of Blakeney and Ima soils. Also included are some areas of Potter soils that; have slopes of 3 to 5 percent and 8 to 12 percent.

The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Most of the acreage is used for range. Erosion can be controlled by maintaining a good cover of grasses. Capability unit VIIs-1, dryland; Very Shallow range site.

Ratliff Series

The Ratliff series consists of deep, nearly level to gently undulating soils. These soils formed in friable, calcareous, loamy sediments on uplands.

In a representative profile, the surface layer is grayish-brown loam about 10 inches thick. The next layer is friable clay loam to a depth of 80 inches. The upper 15 inches of this layer is light brown, the next 20 inches is pink, the next 22 inches is reddish yellow, and the lower part is pinkish gray.

These soils are well drained. Internal drainage is medium; permeability is moderate. The hazard of soil blowing is moderate, and the hazard of water erosion is slight.

Representative profile of a Ratliff loam in an area of Ratliff soils, gently undulating (9 miles east of the Andrews County courthouse, then 12.1 miles south of the intersection of Farm Road 1788 and State Highway 176 then 0.15 mile west of Farm Road 1788):

A1—0 to 10 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky; light brownish-gray platy surface crust 1/8-inch thick; common fine roots and pores; calcareous; moderately alkaline; clear, smooth boundary.

B21—10 to 25 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) when moist; moderate, coarse, prismatic structure parting to fine and medium subangular blocky; slightly hard, friable, slightly sticky; common very fine roots and pores; few films and threads of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

B22ca—25 to 45 inches, pink (7.5Y11 8/4) clay loam, light brown (7.5Y11 6/4) when moist; weak, fine, subangular blocky structure; slightly hard, friable, sticky; estimated 30 percent, by volume, is concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B23ca—45 to 67 inches, reddish-yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) when moist; weak, medium, subangular blocky structure; slightly hard, friable, sticky; estimated 10 percent, by volume, is soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B24ca—67 to 80 Inches, pinkish-gray (7.5YR 7/2) clay loam, pinkish gray (7.5Y11 6/2) when moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky; estimated 30 percent, by volume, is calcium carbonate; common black coatings on peds; calcareous; moderately alkaline.

The A horizon ranges from 8 to 10 inches in thickness and is brown or grayish brown. Texture is mainly loam but ranges to fine sandy loam. The B2 horizon above the B22ca horizon ranges from 15 to 28 inches in thickness and is light brown or pale brown. The Bca horizon begins at a depth of 23 to 38 inches. It is reddish yellow, pink, pinkish gray, or pinkish white. This horizon is an estimated 30 to 50 percent, by volume, soft masses and fragments of calcium carbonate.

Ratliff soils, gently undulating (RAB).—These soils are on uplands in irregular to oval-shaped areas ranging from 20 to 300 acres in size. Slopes are convex and range from 0.5 to 3 percent. Texture of the surface layer is mainly loam but ranges to fine sandy loam.

Included in mapping are small areas of Blakeney and Conger soils. Also included are areas of a soil that is similar to Ratliff soils, except that it has an accumulation of calcium carbonate within 20 inches of the surface.

The hazard of soil blowing is moderate on these soils. Large amounts of crop residue need to be kept on the surface to help control soil blowing and maintain soil tilth. Most of the acreage is used for range. These soils are not suited to dryland farming, but they are suited to irrigated farming. A. few areas are used for cotton and gram sorghum. Capability units VIe-7, dryland, and IIIe-2, irrigated; Mixed Plains range site.

Slaughter Series

The Slaughter series consists of nearly level soils that are shallow over caliche. These soils formed in loamy sediments on uplands.

In a representative profile, the surface layer is dark reddish-gray clay loam about 5 inches thick. The next layer is reddish-brown clay loam about 11 inches thick. It rests abruptly on a layer of indurated caliche that extends to a depth of about 30 inches.

These soils are well drained. Internal drainage is medium; permeability is moderately slow. The hazard of soil blowing is moderate, and the hazard of water erosion is slight.

In this county, the Slaughter soils are mapped in an undifferentiated unit with Stegall soils and in a complex with the Kimbrough soils.

Representative profile of a Slaughter clay loam in an area of Stegall and Slaughter soils (9 miles east of the Andrews County courthouse, then 11.8 miles south of the intersection of Farm Road 1788 and State Highway 176, then 0.9 mile west on county road and 0.1 mile north):

A1—0 to 5 inches, dark reddish-gray (5YR 4/2) clay loam, dark reddish brown (5YR 3/2) when moist; moderate, medium, subangular blocky structure; hard, firm, sticky; many very fine and common fine roots and pores; neutral; abrupt, smooth boundary.

B21t—5 to 8 inches, reddish-brown (YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, blocky structure; extremely hard, firm, sticky; common very fine roots and pores; common thin clay films; neutral; clear, smooth boundary.

B22t—8 to 16 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, blocky structure; extremely hard, firm, sticky; common very fine roots and pores; common thin clay films; neutral; abrupt, wavy boundary.

Ccam—16 to 30 inches, indurated plates of caliche that are laminar in the upper 1/2 inch.

The A horizon ranges from 4 to 8 inches in thickness and is dark reddish gray, brown, or reddish brown. Reaction is neutral or mildly alkaline. The B2t horizon

ranges from 6 to 12 inches in thickness and is reddish brown or brown. Reaction is neutral or mildly alkaline. The Ccam horizon begins at a depth of 10 to 20 inches.

Stegall Series

The Stegall series consists of nearly level soils that are moderately deep over caliche. The soils developed in moderately fine textured sediments on uplands.

In a representative profile, the surface layer is grayish-brown clay loam about 5 inches thick. The next layer is firm clay loam about 24 inches thick. It is dark grayish brown in the upper part and brown in the lower part. A few films and threads of calcium carbonate are in the lower part, which rests abruptly on a layer of indurated caliche that extends to a depth of 40 inches.

These soils are naturally well drained. Internal drainage is medium; permeability is moderately slow. The hazards of soil blowing and water erosion are slight.

In Andrews County, Stegall soils are mapped only in an undifferentiated unit with Slaughter soils.

Representative profile of a Stegall clay loam in an area of Stegall and Slaughter soils (9 miles east of the Andrews County courthouse, then 11.8 miles south of the intersection of Farm Road 1788 and State Highway 176, then 2.9 miles east of Farm Road 1788 on an oilfield road, 0.3 mile north and 25 feet west):

A1—0 to 5 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; hard, firm, sticky; common fine and few medium roots and pores; neutral; clear, smooth boundary.

B21t—5 to 15 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, angular blocky structure; extremely hard, firm, sticky, plastic; few fine and medium roots and pores; common clay films; neutral; clear, smooth boundary.

B22t—15 to 24 inches, brown (7.5YR 5/2) clay loam, brown (7.5Y11 4/2) when moist; moderate, medium, angular blocky structure; extremely hard, firm, sticky, plastic; few fine roots; common thin clay films; neutral; clear, smooth boundary.

B23t—24 to 29 inches, brown (7.5YR 5/4) clay loam, brown (7.5YR 4/4) when moist; moderate, medium, angular blocky structure; extremely hard, firm, sticky, slightly plastic; common thin clay films; few films and threads of calcium carbonate; calcareous; moderately alkaline; abrupt, wavy boundary.

Ccam—29 to 40 inches, indurated plates of caliche that are laminar in the upper 1/2 inch.

The A horizon ranges from 4 to 8 inches in thickness and is brown, grayish brown, or yellowish brown. The B2t horizon ranges from 18 to 29 inches in thickness and is reddish brown, dark grayish brown, or brown. The lower part of this horizon is calcareous in some locations. Reaction is neutral or moderately alkaline. The Ccam horizon begins at a depth of 24 to 36 inches. This horizon consists of indurated plates of caliche that are laminar in the upper 1/2 inch to 2 inches. These plates range from 3 to 10 inches in diameter from 2 to 6 inches in thickness.

Stegall and Slaughter soils (SsA).—These nearly level soils are on smooth plains. They occupy rounded to irregularly shaped areas that range from 30 to several hundred acres in size. Slopes are 0 to 1 percent. These soils have the profiles described as representative for the Stegall and Slaughter series.

Stegall soils make up about 52 percent of the total acreage, and Slaughter soils, 40 percent. Some areas, however, consist of either Stegall or Slaughter soils. Soils of

this undifferentiated unit do not occur in a regular pattern, and it is not feasible to map them separately because their use and management are similar.

The hazard of soil blowing is slight for the Stegall soils and moderate for the Slaughter soils. Most of the acreage is used for range. A few areas are used for cotton and grain sorghum and are suited to irrigated farming. Large amounts of fertilized crop residue need to be kept on the surface to maintain soil tilth and control soil blowing and water erosion. Capability units IVe-3, dryland, and IIe-1, irrigated, for Stegall soils, and capability units VIe-6, dryland, and IIIe-6, irrigated, for Slaughter soils; Deep Hardland range site.

Triomas Series

The Triomas series consists of deep, nearly level to gently undulating soils. These soils formed in eolian, loamy sediments on uplands.

In a representative profile, the surface layer is fine sand, about 16 inches thick, that is brown in the upper 6 inches and reddish brown in the lower 10 inches. The next layer is friable sandy clay loam to a depth of 80 inches. This layer is red in the upper 36 inches, light red in the next 16 inches, and reddish yellow in the lower part (fig. 10).

***Figure 10.*—Profile of Triomas fine sand showing thickness of the A horizon. Here, the A horizon is 16 inches thick.**

These soils are well drained. Internal drainage is medium; permeability is moderate. The hazard of soil blowing is severe, and the hazard of water erosion is slight.

Representative profile of Triomas fine sand in an area of Triomas and Wickett soils, gently undulating (11 miles north of Andrews County courthouse on U.S. Highway 385, then 2 miles west on county road, then 1.1 miles north):

A11—0 to 6 inches, brown (7.5YR 5/4) fine sand, dark brown (7.5YR 4/4) when moist; single grain; loose, nonsticky; common very fine and fine roots; neutral; gradual, smooth boundary.

A12—6 to 16 inches, reddish-brown (5YR 5/4) fine sand, reddish brown (5YR 4/4) when moist; single grain; loose, nonsticky; common very fine roots; neutral; clear, smooth boundary.

B21t—16 to 36 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, friable, sticky; common very fine roots and pores; few thin clay films; neutral; gradual, smooth boundary.

B22t—36 to 52 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, friable, sticky; few fine pores; few thin clay films; neutral; gradual, smooth boundary.

B23t—52 to 68 inches, light-red (2.5YR 6/5) sandy clay loam, red (2.5YR 5/8) when moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable, sticky; fine and very fine pores; few thin clay films on faces of peds; few very small pockets of clean sand grains; mildly alkaline; clear, wavy boundary.

B24tca—68 to 80 incites, reddish-yellow (5YR 7/6) sandy clay loam, reddish yellow (5YR 6/6) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable, slightly sticky; few thin clay films; about 25 percent visible calcium carbonate in soft masses; calcareous; moderately alkaline.

The A horizon ranges from 10 to 20 inches in thickness and is reddish brown or brown. Texture is dominantly fine sand but ranges to loamy flue sand. The Bt horizon above the Btca horizon ranges from 46 to 56 inches in thickness and is red, light red, reddish brown, or yellowish red. The Btca horizon is at depths of more than 60 inches and does not. occur in all places.

Triomas loamy fine sand, 0 to 3 percent slopes (TrB).—These nearly level to gently sloping soil is on uplands. It occupies irregularly shaped areas that range from 100 to 300 acres in size but are generally about 200 acres. The surface layer is reddish-brown loamy fine sand about 15 inches thick. The next layer is red sandy clay loam about 45 inches thick. The next lower layer, to a depth of 75 inches, is reddish-yellow sandy clay loam. Included in mapping are small areas of Wickett and Faskin soils.

The hazard of soil blowing is severe on this soil. Most of the acreage is used for range. This soil is not suite to dryland farming, but it is suited to irrigated farming. A few areas are used for cotton and grain sorghum. Large amounts of crop residue need to be kept on the surface to help control soil blowing and to help maintain soil tilth. Capability units VIe-1, dryland, and IIIe-5, irrigated; Sandyland range site.

Triomas and Wickett soils, gently undulating (TWB).—These soils are on uplands. They occupy irregular to oblong-shaped areas ranging from 100 to several thousand acres in size. Slopes range from 0 to 5 percent. These soils have the profiles described as representative for the Triomas and Wickett series.

Triomas soils make up about 78 percent of the total acreage, and Wickett soils, about 16 percent. Some of the smaller areas consist of either Triomas or Wickett soils. 'The remaining 6 percent is mainly Douro, Ima, and Jalmar soils and a soil that is similar to Wickett soils, except that it is less than 20 inches deep over indurated caliche. Soils of this undifferentiated unit do not occur together in regular patterns, but it is not feasible to separate them in mapping because their use and management are similar.

The hazard of soil blowing is severe on these soils. Most of the acreage is used for range. These soils are not suited to dryland farming but are suited to irrigated farming. A. few areas are used for cotton and grain sorghum. Large amounts of crop residue need to be kept on the soil surface to help control soil blowing and maintain soil tilth. Capability units VIe-1, dryland, and IIIe-5, irrigated; Sandyland range site.

Wickett Series

The Wickett series consists of nearly level to gently undulating soils that are moderately deep over caliche. These soils formed in loamy sediments over indurated caliche on uplands.

In a representative profile, the surface layer is reddish-brown loamy fine sand about 16 inches thick. The next layer is a yellowish-red fine sandy loam about; 17 inches thick. It rests abruptly on a layer of indurated platy caliche.

These soils are well drained. Internal drainage is medium; permeability is moderately rapid. The hazard of soil blowing is severe, and the hazard of water erosion is slight.

In this county, the Wickett soils are mapped only in an undifferentiated unit with Triomas soils.

Representative profile of Wickett loamy fine sand in an area of Triomas and Wickett soils, gently undulating (13.6 miles south of Andrews County courthouse on U.S. Highway 385, then 2 miles east on county road, then 5 miles north and 0.25 mile west):

A1—0 to 16 inches, reddish-brown (5Y11 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; single grain; loose, nonsticky; common very fine and fine roots; mildly alkaline; clear, smooth boundary.

B2t—16 to 33 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; moderate, coarse, prismatic structure parting to weak subangular blocky; slightly hard, friable, slightly sticky; few thin clay films and grains coated and bridged with clay; mildly alkaline; abrupt, wavy boundary.

C1cam—33 to 53 inches, indurated platy caliche; laminar in the upper 1 inch, strongly cemented in lower part; clear, wavy boundary.

C2ca—53 to 67 inches, weakly cemented caliche; estimated visible calcium carbonate about 50 percent.

The A horizon ranges from 8 to 20 inches in thickness and is reddish brown or brown. Reaction is neutral or mildly alkaline. The B2t horizon ranges from 12 to 20 inches in thickness and is reddish brown or yellowish red. The C1cam horizon begins at a depth of 20 to 40 inches. The caliche plates range from 2 to 8 inches in diameter and from 1/2 to 8 inches in thickness. They are laminar in the upper 1/2 inch to 3 inches.

Use and Management of the Soils

This section discusses the use and management of the soils for crops. It gives a brief description of irrigation in the county and predicts estimated crop yield on

different soils. It also discusses range management, engineering uses of soils, and use of the soils for wildlife.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations, the risk of damage when used for field crops, and the way they respond to treatment. The grouping does not take into account major and generally expensive Landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range or for engineering.

In the capability system, kinds of soil are grouped at three levels: capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants, require moderate conservation practices, or both.

Class Ill soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit; their use largely to pasture, range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

Capability subclasses are soil groups within one class; they are designated by adding a small letter *e*, *w*, *s*, or *c*, to the class numeral; for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require

similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example IVe-3 or VIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the preceding paragraph; and the Arabic numeral specifically identities the capability unit within each subclass.

The capability units in Andrews County are described as follows:

IIe-1, irrigated.—Moderately deep, moderately slowly permeable clay loams.
IIe-2, irrigated.—Deep, moderately permeable clay loams.
IIIe-2, irrigated.—Deep, moderately permeable loams.
IIIe-3, irrigated.—Deep to moderately deep, moderately permeable fine sandy loams.
IIIe-5, irrigated.—Deep to moderately deep, moderately permeable and moderately rapidly permeable fine sands and loamy fine sands.
IIIe-6 irrigated.—Shallow, moderately slowly to moderately rapidly permeable fine sandy loams, loams, and clay loams.
IVe-2, irrigated.—Deep, moderately permeable fine sands.
IVe-1, dryland.—Deep to moderately deep, moderately permeable fine sandy loams.
IVe-2, dryland.—Deep, moderately permeable clay loams.
IVe-3, dryland.—Moderately deep, moderately slowly permeable clay loams.
VIe-1, dryland.—deep to moderately deep, moderately permeable and moderately rapidly permeable fine sands and loamy fine sands.
VIe-2, dryland.—Shallow, moderately permeable to moderately rapidly permeable fine sandy loams and loams.
VIe-3, dryland.—Deep, moderately permeable fine sands.
Vle-4, dryland.—Deep, moderately rapidly permeable fine sandy loams.
Vle-5, dryland.—Deep, moderately rapidly permeable, calcareous loamy fine sands.
Vle-6, dryland.—Shallow, moderately slowly permeable clay loams.
Vle-7, dryland.—Deep, moderately permeable loams.
VIw-1, dryland.—Deep, very slowly permeable clays.
VIIe-1 dryland.—Deep, rapidly permeable fine sands.
VIIs-1, dryland.—Very shallow to shallow, moderately permeable and moderately slowly permeable clay loams and loams.
VIIIe, dryland.—Deep, rapidly permeable sands.

Predicted Yields

Crop yields in Andrews County depend on the kind of management the soils receive. Consistently high yields can be obtained if the soils are used within their capabilities and are managed according to their needs.

Table 2 lists all the mapping units in the county and gives, for each soil that is cultivated, predicted average yields per acre under a high level of management. These predictions are for cotton and grain sorghum grown on dryland and irrigated soils. The predictions are based on information obtained from farmers and others familiar with the soils.

Under a high level of management, the following practices are used for dryland farming:

1. Moisture is conserved.
2. Crop residue is used to help control soil blowing and water erosion.
3. Soil tillage and insect and weed control are timely.

4. Improved varieties of crops and improved methods of farming are employed.

Under a high level of management, the following practices are used for irrigation farming:

1. A properly designed irrigation system is used.
2. Rainfall is conserved.
3. Fertilizers are used according to the needs of the crop.
4. Crop residue is used for maximum soil cover.
5. Improved varieties of crops and improved methods of farming are employed.
6. Soil tillage and insect and weed control are timely.

Irrigation

Andrews County has 8,000 acres of irrigated cropland. Of this, approximately 5,000 acres are in cotton, and the remaining acres are used for grain sorghum. Wells are 125 to 150 feet deep, and water is pumped from the Ogallala Formation.

Most of the irrigated soils are fine sandy barns, loams, or line sands of the Faskin, Douro, Ratliff, and Triomas series. Water is pumped from the irrigation wells into a sprinkler irrigation system. Some of the systems are moved over the field by hand, and others are the self-propelled type.

Soils in Andrews County are best suited to a sprinkler irrigation system. Irrigation systems need to be designed to prevent soil and water losses. Cropping systems on irrigated soils should include crops in the rotation that produce large amounts of crop residue. Crop residue kept on the surface helps to maintain favorable soil conditions and control soil blowing and water erosion.

Most irrigated farmland responds to commercial fertilizers. A soil test should be used to determine the amount of fertilizer needed.

Range Management

By Joe B. Norris, range conservationist, Soil Conservation Service, Abilene, Texas.

Ranching is the most important farm enterprise in Andrews County. Native grasses cover about 94 percent of the total acreage. The 40 ranches in the county range from 2,000 to 110,000 acres in size, but the average is 22,000 acres. Since average annual rainfall is 13.9 inches, grass production is normally sparse.

Most of the grassland in the county is on coarse, sandy soils that favor growth of many kinds of grasses and forbs. The sands and deep sands produce mid and tall grasses; the sandy loams produce primarily mid grasses and lesser amounts of tall grasses where moisture supply is more favorable; and the small areas of clay loams, short grasses. Soils that have a high content of lime produce salt-tolerant short or mid grasses and are confined to areas surrounding salt lakes. Shallow soils occur throughout the county.

The native grassland has been heavily grazed for several generations. As a result, a high percentage of the more desirable grasses and forbs have been grazed out. This has permitted less desirable grasses, weeds, and brush to invade. The sandy soils commonly produce an over abundance of shin oak and low-order dropseeds instead of the taller, more robust grasses. The more clayey soils have been invaded by mesquite. The shallow sites now produce an over abundance of noxious weeds.

A close look at all of these sites, however, reveals remnants of the original adapted species. Generally, these species increase if the grassland is given proper care and treatment.

Range sites and condition classes

Range sites are distinctive kinds of rangeland that have a different potential for producing forage plants. Range sites differ from each other in their ability to produce significantly different kinds or proportions of plant species or total annual yield. Significant differences are those great enough to require some variation in management, such as a different rate of socking.

Differences in kinds, proportion, and production of plants that different sites are capable of supporting are due in large measure to variations in environmental factors such as soil, topography, and climate. Therefore, range sites can be identified by the kinds of soil known to be capable of producing the distinctive potential plant community characteristic of a specific site.

Most of the native grassland in Andrews County has been heavily grazed for several generations, and the original plant cover has been altered. *Range condition* is the present state of the vegetation of a range site in relation to the potential plant cover (climax) for that site. *Range condition classes* measure the degree to which the present plant composition, expressed in percent, resembles that of the climax plant community of a range site.

A range is in *excellent* condition if 76 to 100 percent of the vegetation is of the same kind as that in the original stand; in *good* condition if 51 to 75 percent of the vegetation is of the same kind as that in the original stand; in *fair* condition if 26 to 50 percent of the vegetation is of the same kind as that in the original stand; and in *poor* condition if 0 to 25 percent of the vegetation is of the same kind as that in the original stand.

In determining present range condition class, plants are grouped in accordance with their response to the degree of grazing they receive on specific range sites. These groups of plants are *decreasers, increasers,* and *invaders.*

Decreaser plants are members of the potential plant community or climax plant cover that decrease in relative abundance if they are subject to continued heavy grazing use. Most of these plants have a high grazing preference and decrease from excessive use. The total of all such species is counted in determining range condition class.

Increaser plants are species in the climax community that normally increase in relative abundance when the community is subjected to continued heavy grazing use. Some increasers with moderately high grazing preference may initially increase and then decrease as grazing pressure continues. Others of low grazing preference may continue to increase either in actual plant numbers or in relative proportions. Only the percentages of increaser plants normally expected to occur in the climax community are counted in determining range condition.

Invader plants are not members of the climax plant community for the site. They invade the community as a result of various kinds of disturbance. They may be annuals or perennials and may be grasses, weeds, or woody plants. Some have, relatively high grazing value, but many are worthless. Invader plants are not counted in determining range condition class.

For most range sites and most range livestock operations, the higher the range condition class, the greater the quality and amount of available forage.

Descriptions of range sites

Eight range sites are described in the following pages, and the climax plants and, in some cases, the principal invaders are named. Also given is the estimated annual yield of air-dry herbage for each site when it is in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units." Dune land and Lipan clay have not been placed in a range site.

Deep Hardland range site

This site consists of nearly level to gently undulating, moderately fine textured soils on mostly smooth upland plains. It is accessible to livestock and is a favorite for grazing (fig. 11). The soils in this site are moderately slowly permeable and have a low to high available water capacity. In many places the intake of moisture is reduced by surface crusting and by the compacted layer, or hoof pan, caused by trampling.

***Figure* 11.—Tobosagrass, buffalograss, and blue grama on an area of Stegall and Slaughter soils that have a clay loam surface layer. These soils are in the Deep Hardland range site.**

The climax plant cover on this site is about 40 percent blue grama, 25 percent buffalograss, 15 percent tobosagrass, and smaller amounts of western wheatgrass, vine-mesquite, feathery bluestem, sand dropseed, and perennial three-awn. Continuous overgrazing results in an immediate loss of blue grama. Further deterioration of the range results in invasion by perennial three-awn, hairy tridens, broom snakeweed, and mesquite.

If the range condition is deteriorating and during years in which there is a wet spring, annuals invade the bare spots. The most common invaders are Texas filaree, evax, various plantains, bladderpod, plains greenthread, bitterweed actinea, common broomweed, and little barley. The common perennial forbs that invade this site are western ragweed, silverleaf night shade, and Dakota verbena.

This site is capable of only limited production. Vegetative cover is necessary to reduce surface crusting and to prevent erosion. Once the range is in poor condition, recovery is very slow because of the lack of desirable seed plants, crusted soils, and heavy infestation of mesquite.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,200 to 2,500 pounds per acre, depending on rainfall. About 55 percent of this yield is forage for livestock and wildlife.

Deep Sand range site

This site consists of nearly level to gently undulating and hummocky soils. Commonly, the soils give the appearance of stabilized dunes (fig. 12).

The soils are deep, moderately to rapidly permeable fine sands. Available water capacity is low to moderate. The site deteriorates rapidly under continued heavy grazing but responds favorably to good management.

***Figure 12.*—Deep Sand range site on which the major grasses are giant dropseed and bluestem. This site is normally invaded by shinnery (Havard oak). The soils are Jalmar and Penwell fine sands in the Jalmar-Penwell association, undulating.**

The climax plant cover on this site is about 20 percent sand bluegrass, 20 percent little bluestem, 20 percent giant dropseed, and smaller amounts of spike dropseed, Havard panicgrass, sand dropseed, perennial three-awn, Havard oak, and hairy grama.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,000 to 2,500 pounds per acre, depending on rainfall. About two-thirds of this yield is suitable forage for livestock and wildlife.

High Lime range site

This site consists of undulating soils on the east and northeast sides of large lakes. It is generally 30 to 50 feet higher than surrounding sites. These soils are moderately rapidly permeable, high in content of lime, and moderately coarse textured (fig. 13). The available water capacity is moderate.

It is difficult to determine the exact composition of the climax vegetation because these areas commonly are high in salt content. The percentage of salt generally is highest adjacent to the lakes, where vegetation is limited to salt-tolerant species such as alkali sacaton. This vegetation normally grades into less salt-tolerant vegetation as the distance from the lakes increases.

The climax plant cover on this site is about 25 percent alkali sacaton, 20 percent side-oats grama, 15 percent blue grama, and smaller amounts of vine-mesquite,

plains bristlegrass, black grama, slim tridens, sand dropseed, hooded windmillgrass, and fall witchgrass.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 800 to 1,500 pounds per acre, depending on rainfall. About 80 percent of this yield is suitable forage for livestock and wildlife.

***Figure 13.*—An area of the High Lime range site where the major grasses are alkali sacaton and black grama. The soil is Krade fine sandy loam in the mapping unit Krade soils, undulating.**

Mixed Plains range site

This site consists of nearly level to gently undulating soils on broad plains. These, soils are medium textured to moderately coarse textured. Permeability is moderately to moderately rapid, and available water capacity is low to moderate.

The climax plant, cover on this site is about 20 percent side-oats grama, 15 percent blue grama, and smaller amounts of silver bluestem, vine-mesquite, black grama, alkali sacaton, fall witchgrass, hairy grama, perennial three-awn, sand dropseed, buffalograss, and four-winged saltbush (fig. 14).

The kind of vegetation on this site varies widely, depending on the amount of salt in the soil. In some places where the salt content is high, alkali sacaton makes up a high percentage of the total composition.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 900 to 2,100 pounds per acre, depending on rainfall. About 75 to 80 percent of this yield is suitable forage for livestock and wildlife.

***Figure 14.*—An area of the Mixed Plains range site where the major grasses are black grama, blue grama, and silver bluestem.**

Sandyland range site

This site consists of smooth and nearly level to gently sloping and gently undulating soils. These soils are coarse textured are moderately permeable to moderately rapidly permeable, and have a low to moderate available water capacity. If properly managed, they produce a good stand of mid and tall grasses (fig. 15).

The climax plant cover on this site is about 25 percent little bluestem, 20 percent side-oats grama, 15 percent giant dropseed, and smaller amounts of spike dropseed, mesa, dropseed, fall witchgrass, sand dropseed, perennial three-awn, sand bluestem, hairy grama, and Havard oak.

Any deterioration of this site results in a rapid increase of small soapweed (yucca), shin oak, and annuals. Invading grasses include annual three-awn, fringed signal-grass, tumble windmillgrass, gummy lovegrass, red love-grass, and tumble lovegrass. The chief invading weeds are tumble ringwing, annual wildbuckwheat, prairie sunflower, woolywhite, beebalm, pricklypoppy, Riddel grounsel, and stillingia.

Shin oak readily invades the site. On many ranches it must be controlled before grasses can make satisfactory recovery. Mechanical methods of control are not feasible, because soil blowing is a severe hazard. The site responds favorably to chemical control of shin oak.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 800 to 2,000 pounds per acre, depending on rainfall. About two-thirds of this yield is suitable forage for livestock and wildlife.

Figure 15.—**An area of the Sandyland range site where the major grasses are sand dropseed and black grama. The soil is Triomas fine sand in the mapping unit Triomas and Wickett soils, gently undulating.**

Sandy Loam range site

This site consists of nearly level to gently undulating, moderately coarse textured soils on upland plains (fig. 16). Permeability is moderate to rapid, and available water capacity is low to moderate. Hoof pans and surface crusts form readily if the site is unprotected by plant cover.

The climax plant cover on this site is about 20 percent blue grama, 15 percent side-oats grama, 15 percent Arizona cottontop, 15 percent plains bristlegrass, and smaller amounts of buffalograss, black grama, sand dropseed, perennial three-awn, hooded windmillgrass, feathery bluestem, little bluestem, and fall witchgrass.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,200 to 2,000 pounds per acre, depending on rainfall. About two-thirds of this yield is suitable forage for livestock and wildlife.

***Figure 16.*—An area of the Sandy Loam range site where the major grasses are black grama, sand dropseed, and plains bristlegrass. The soils are Faskin and Douro fine sandy loams in the mapping unit Faskin and Douro soils, gently undulating.**

Valley range site

This site consists of nearly level, moderately fine textured soils in the major draws. These soils are moderately permeable, and the available water capacity is high. Extra water is received as runoff from adjacent soils. Although flooded from time to time, the site is under water for only a short period. Thus, any damage to vegetation is ordinarily from sedimentation rather than from wetness. The composition of climax vegetation depends on the depth of the soil and the frequency that extra water is received.

The climax plant cover on this site is about 25 percent side-oats grama, 20 percent cane bluestem, 20 percent blue grama, 15 percent vine-mesquite, and smaller amounts of white tridens, buffalograss, and tobosagrass.

This site responds favorably to rest, particularly if management is applied before, all the more desirable grasses are grazed out.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 1,500 to 2,000 pounds per acre, depending on rainfall. About 90 percent of this yield is suitable forage for cattle.

Very Shallow range site

This site consists of nearly level to gently undulating and sloping soils on uplands. The soils are medium textured, calcareous, and moderately permeable. They are underlain by caliche. The available water capacity is low.

The stand of grass is sparse, but the site generally is in better condition than adjacent sites (fig. 17). Generally enough of the better grasses remain to allow management that improves the vegetation.

***Figure* 17.—An area of the Very Shallow range site where the plants are black grama and plains bristlegrass. The soils are Kimbrough soils, gently undulating.**

The climax plant cover on this site is about 25 percent side oats grama, 15 percent blue grama, 15 percent black grama,15 percent feathery bluestem, and smaller amounts of little bluestem, sand bluestem, indiangrass, plains bristlegrass, New Mexico feathergrass, and fall witchgrass.

If the site is in excellent condition, the total annual yield of air-dry herbage ranges from 400 to 850 pounds per acre, depending on rainfall. Sixty percent of this yield is considered suitable livestock forage.

Engineering Uses of the Soils

By Beade O. Northcut, civil engineer, Soil Conservation Service, Big Spring, Texas.

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural or foundation material. Properties of the soils that affect construction and maintenance of roads and airports, pipelines, building foundations, water storage facilities, erosion control structures, and sewage disposal systems are in this section. Among the soil properties most important in engineering arc permeability, compressibility, compaction characteristics, shear strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction.

Information concerning these and related soil properties are furnished in tables 3, 4, and 5. The estimates and interpretations of soil properties in these tables can be used in:

1. Planning of agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and other structures for controlling water and conserving soil.
2. Selecting potential locations for highways, airports, pipelines, and underground cables.

3. Selecting potential industrial, commercial, residential, and recreational areas.

The engineering interpretations in this soil survey do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. The estimated values for traffic-supporting capacity expressed in words should not be assigned specific values. There are small areas of other soils and contrasting situations included in the mapping units that may have different engineering properties than those listed. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems to be expected.

Engineering classifications

The two systems most commonly used in classifying samples of soil horizons for engineering are the AASHO system adopted by the American Association of State Highway Officials (1), and the Unified Soil Classification system (7) used by the Soil Conservation Service engineers, Department of Defense, and others.

The AASHO system is used to classify soils according to those properties that affect use, in highway construction. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index.

In group A-1 are gravelly soils of high hearing strength, or the best soils for subgrade (foundation) and, at the other extreme, clay soils that have low strength when wet. The best soils for subgrade are therefore classified as A-1, the next best A-2. and so to class A-7, the poorest soils for subgrade. If laboratory data are available to justify a breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b; A-2-4, A-2-5, A-2-6, A-2-7; and A-7-5 and A-7-6. If soil material is near a, classification boundary it is given a symbol showing both classes; for example, A-2 or A-4. Within each group, the relative engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with index numbers in parentheses, is shown in table 5; the estimated classification, without group index numbers, is given in table 3 for all soils mapped in the county.

In the Unified system soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as CW, GP, GM, CC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CH or MH.

Soil properties significant in engineering

Table 3 provides estimates of soil properties important to engineering. The estimates are based on field classification and description, physical and chemical tests of selected representative samples, test data from comparable soils in adjacent areas, and detailed experience in working with the individual kind of soil in the survey area.

Hydrologic soil groups are used in watershed planning to estimate runoff from rainfall. Soil properties are considered that influence the minimum rate of infiltration obtained for a bare soil *after prolonged wetting.* These properties are: depth of seasonally high water table, intake rate and permeability after prolonged wetting, and depth to very slowly permeable layer. The influence of ground cover is treated independently—not in hydrologic soil groups.

The soils have been classified into four groups, A through D.

A. (Low runoff potential). Soils having a high infiltration rate, even when thoroughly wetted. They are chiefly deep, well-drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

B. (Moderately low runoff potential). Soils having a moderate infiltration rate when thoroughly wetted. They are chiefly moderately deep to deep, moderately well drained to well drained soils that have a moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission.

C. (Moderately high runoff potential). Soils having a slow infiltration rate when thoroughly wetted. They are chiefly soils that have a layer that impedes downward movement of water, soils that have a moderately fine to fine texture, or soils that have a moderately deep water table. These soils may be somewhat poorly drained.

D. (High runoff potential). Soils having a very slow infiltration rate when thoroughly wetted. They are chiefly clay soils that have a high swelling potential, a permanent high water table, or a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

Permeability, as used table 3, relates only to movement of water downward through undisturbed and uncompacted soil. It does not include lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other properties resulting from use of the soils are not considered. The values used in the table should not be confused with the coefficient of permeability of "K" used by engineers.

Available water capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is expressed as inches of water per inch of soil.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and relative terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

Engineering interpretations

Table 4 contains selected information useful to engineers and others who plan to use material in the construction of highways, farm facilities, buildings, sewage disposal systems, and recreational facilities. Detrimental or undesirable features are emphasized, but very important desirable features also may be listed. The ratings and other interpretations in this table are based on estimated engineering properties of the soils in table 3; on available test data, including those in table 5; and on field experience. Strictly, the information applies only to soil depths indicated in table 3, but it is reasonably reliable to depths of about 6 feet for most soils and several more feet for some soils.

Topsoil is a term used to designate a fertile soil or soil material, ordinarily rich in organic matter, used as a top dressing for lawns, gardens, roadbanks, and the like. The ratings indicate suitability for such use.

Road subgrade is material used to build embankments. The ratings indicate suitability of soil material moved from borrow areas for these purposes.

Highway location is influenced by features of the undisturbed soil that affect construction and maintenance of highways. The soil features listed, favorable as well as unfavorable, are the principal ones that affect geographic locations of highways.

Foundations for low buildings are affected chiefly by features of the undisturbed soil that influence its capability to support low buildings that have normal foundation loads.

Septic tank filter fields are affected mainly by permeability, location of water table, and susceptibility to flooding. The degree of limitation and principal reasons for assigning moderate or severe limitations are given.

Sewage lagoons are influenced chiefly by soil features such as permeability, location of water table, and slope. The degree of limitation and principal reasons for assigning moderate or severe limitations are given.

Camp areas are areas used intensively for tents and small camp trailers and the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and leveling for tent and parking areas. The soils should be suitable for heavy foot; traffic and for limited vehicular traffic. Soil suitability for growing and maintaining vegetation is not a part of this evaluation but is an item to consider in the final evaluation of a site.

Picnic areas are areas used intensively as park-type picnic areas. It is assumed that most vehicular traffic will be confined to access roads. Soil suitability for growing vegetation is not a part of this evaluation but is an item to consider in the final evaluation of a site.

Playgrounds are areas used for baseball, football, badminton, and other similar organized games. These areas are subject to intensive foot traffic. A nearly level surface, good drainage, and a soil texture and consistence that gives a firm surface are generally required. The most desirable soils are free of rock outcrops and coarse fragments. Soil suitability for growing vegetation is not a part of this evaluation but is an important item to consider in the final evaluation of a site.

Paths and trails applies to soils to be used for local and cross-country footpaths and trails and for bridle paths. It is assumed that, these areas will be used as they occur in nature and that little or no soil will be moved (excavated or filled). Soil features that affect trafficability, dust, design, and maintenance of trafficways are given special emphasis in this evaluation.

Irrigation is affected by such factors as soil texture, water-intake rate, erodibility, and available water capacity.

Corrosivity as used here, indicates the potential danger to buried, uncoated steel structures through chemical action of the soil that dissolves or weakens the structural material. Corrosivity of concrete structures is not a problem in Andrews County. Structural materials may corrode when buried in soil, and a given material corrodes in some kinds of soil more rapidly than in others. Extensive installations that intersect soil boundaries or soil horizons are more likely to be damaged by corrosion than are installations entirely in one kind of soil or soil horizon. Ratings for corrosivity are based on soil conditions at a depth of 5 feet.

Interpretations for several engineering uses of soils are not given in table 4. None of the soils in Andrews County is a good source of sand and gravel, but the Penwell, Triomas, and Wickett soils are a fair source of sand in some places. Most soils in the county have severe limitations for the reservoir areas and embankments of farm ponds, though the limitation for this use is only slight on Lipan soils and is moderate on Faskin soils. Use of terraces, diversions, and waterways is not advisable in Andrews County. Soil blowing fills terrace channels and grassed waterways too quickly for installation to be feasible. Water erosion is not a severe hazard on soils of the county. Drainage and salinity are not limitations.

Engineering test data

Table 5 contains the results of engineering tests per-formed by the Texas Highway Department on three important soils in Andrews County, Texas. The table shows the specific locations where samples were taken, the depth to which sampling was done, and the results of tests to determine particle-size distribution and other properties significant in soil engineering.

Following are definitions of some of the properties included in table 5. The columns not discussed are self-explanatory or are defined elsewhere in this survey.

Shrinkage limit.—As moisture leaves a soil, the soil shrinks and decreases in volume in direct proportion to the loss in moisture until a condition of equilibrium is reached. Shrinkage limit is reached when further reduction of moisture does not result in shrinkage of the soil. It is reported as a percentage of the oven-dry weight of soil.

Linear shrinkage.—Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the stipulated percentage to the shrinkage limit.

Shrinkage ratio.—The shrinkage ratio is the volume change (expressed as a percentage of the volume of the dry soil pat) divided by the moisture loss above the shrinkage limit (expressed as a percentage of the weight of the dry soil pat).

Liquid limit.—The liquid limit is the percentage of moisture at which a soil passes from a plastic to a liquid state.

Plasticity index.—The plasticity index is defined as the numerical difference between the liquid limit and the plastic limit (the percentage of moisture at which a soil changes from a semisolid to a plastic state).

Use of the Soils for Wildlife

By James Henson, biologist, Soil Conservation Service, San Angelo, Texas.

In Andrews County the principal kinds of wildlife are antelope, jackrabbit, cottontail rabbit, bobwhite quail, and scaled (blue) quail. Also present are raccoon, skunk, and other furbearers. Many species of nongame birds, reptiles, and small mammals are in the county. The common predators are bobcat and coyote.

Small game hunting centers around quail and dove. Because of the migratory habit of doves, the supply is erratic. The quail population is more dependable; however, it varies with rainfall and range conditions. Big game hunting in Andrews County is limited to antelope.

Successful management of wildlife on any tract of land requires that food, cover, and water be available in a suitable combination. Lack of any one of these necessities, an unfavorable balance between them, or inadequate distribution of them may severely limit or account for the absence of desired wildlife species. Soil information provides a valuable tool in creating, improving, or maintaining a suitable habitat for wildlife.

Most wildlife habitats are managed by planting suitable vegetation, by manipulating existing vegetation to bring about natural establishment or improvement of desired plants, or by combinations of such measures. The possible influence of a soil on the growth of plants is known for many species and can be inferred for others from a knowledge of the characteristics and behavior of the soil. In addition, water areas can be created or natural ones improved as wildlife habitats.

Soil interpretations are an aid in selecting the more suitable sites for various kinds of wildlife management. They serve as indicators of the level of management intensity needed to achieve satisfactory results. They also show why it may not be generally feasible to manage a particular area for a given kind of wildlife. These interpretations are also useful in broad-scale planning of wildlife management areas, parks, and nature areas or for acquiring wildlife areas.

Soil properties that affect the growth of wildlife habitat are: (1) thickness of soil useful for crops; (2) texture of the surface layer; (3) available water capacity to a 40-inch depth; (4) degree of wetness; (5) surface stoniness or rockiness; (6) flood hazard; and (7) slope.

The areas shown on the map are rated without regard to positional relationships with adjoining areas. The size, shape, or location of the outlined area does not affect the rating. Certain influences on habitats, such as elevation and aspect, must be appraised onsite.

Table 6 lists the soils of the county and rates their suitability for the creation, improvement, or maintenance of six elements of wildlife habitat. These ratings are based on limitations imposed by characteristics of the soils. The ratings are *well suited, suited, poorly suited,* and *unsuited.* They are defined in the following paragraphs.

Well suited indicates that habitats generally are easily created, improved, or maintained; that the soil has few or no limitations that affect management; and that satisfactory results can be expected.

Suited indicates that habitats can be created, improved, or maintained in most places; that the soil has moderate limitations that affect management; and that moderate intensity of management and fairly frequent attention may be required for satisfactory results.

Poorly suited indicates that habitats can be created, improved, or maintained in most places; that the soil has rather severe limitations; that habitat management is difficult and expensive and requires intensive effort; and that results are not always satisfactory.

Unsuited indicates that the soil limitation is so extreme that it is impractical, if not impossible, to manage the designated habitat element. Unsatisfactory results are probable. (For short-term use, soils rated as poorly suited may provide easy establishment and temporary values.)

The six habitat elements rated in table 6 are discussed in the following paragraphs.

Grain and seed crops consist of agricultural grains or seed-producing annuals planted to produce food for wildlife. Examples are corn, sorghum, millet, soybeans, wheat, oats, and sunflowers.

Grasses and legumes consist of domestic perennial grasses and legumes that are established by planting and that furnish food and cover for wildlife. Examples are plains bristlegrass, switchgrass, weeping lovegrass, vine-mesquite, and panicgrass. Legumes includes clover, annual lespedeza, bush lespedeza, and cowpeas.

Wild herbaceous upland plants are perennial grasses, forbs, and weeds that provide food and cover for wildlife. Examples are beggarweed, perennial lespedeza, wild bean, indiangrass, wild ryegrass, plains bristlegrass, wild buckwheat, Havard panicum, croton, and bluestem.

Hardwood trees and shrubs are nonconiferous trees, shrubs, and woody vines that produce fruits, nuts, buds, catkins, or foliage (browse) used extensively as food by wildlife. These plants commonly become established through natural processes, but they may be planted. Examples are shin oak, mesquite, whitebrush, catclaw, wild plum, Russian-olive, desert-willow, Arizona cypress, redcedar, and Osage-orange.

Wetland food and cover plants consist of annual and perennial wild herbaceous plants in moist to wet sites, exclusive of submerged or floating aquatic plants, that produce food or cover that is extensively and dominantly used by wetland forms of wildlife. Examples are smartweed, wild millet, bulrush, spike-sedge, rushes, sedges, burreed, wildrice, cutgrass, sourdock, and cattails.

Shallow water developments are low dikes and water control structures established to create habitats, principally for waterfowl. They may be designed so that they can be drained, planted, and flooded or they may be used as permanent

impoundments to grow submerged aquatics. Both freshwater and brackish water developments are included.

The three general kinds of wildlife rated in table 6 are defined as follows:

Openland wildlife refers to birds and mammals that normally frequent farmed areas, pastures, and areas overgrown with grasses, herbs, and shrubs. Examples of openland wildlife are antelope, cottontail rabbit, jack-rabbit, quail, and the many species of nongame birds.

Brushland wildlife refers to birds and mammals that normally frequent areas of hardwood trees and shrubs. Examples of brushland wildlife are deer, turkey, squirrel, raccoon, and the various species of nongame birds that are associated with these areas.

Wetland wildlife refers to birds and mammals that normally frequent ponds, streams, ditches, marshes, and swamps. Examples of wetland wildlife are ducks, geese, rails, shorebirds, and snipe.

Formation and Classification of the Soils

This section discusses the five factors that affect soil formation in Andrews County. Also, the current system of soil classification is explained and the soils in the county are placed in some categories of the system.

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agents. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material.

Climate and vegetation are active factors of soil genesis. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. It may be much or little, but some time is always required for horizon differentiation. Usually a long time is required for the development of distinct horizons.

The factors of soil genesis are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one unless conditions are specified for the other four.

Parent material

Parent material refers to the unconsolidated mass in which the soil develops. The soils in Andrews County developed in eolian and alluvial deposits of the Quaternary and late Tertiary periods that have been reworked by soil-building forces. These deposits are mostly sandy and silty sediments that are unconsolidated, calcareous, and alkaline. The Faskin soils developed in these sediments.

Some soils developed over a geological stratum called the Ogallala Formation. The parent material was deposited over the mantle of indurated caliche and was subjected to soil-forming processes. Examples of this are the Stegall and Slaughter soils.

Potter soils, located on the sides of Monument and Seminole Draws, developed in parent material derived from the weathering of exposed caliche.

Portales soils, located in the bottom of Monument and Seminole Draws, developed in material transported by water and subjected to soil-blowing forces.

The removal of the silt and clay particles from the parent material by wind led to the development of the Ima soils.

Climate

Andrews County has a cool-temperate, dry steppe climate characterized by low rainfall and rapid evaporation. Soils such as those of the Ima, Ratliff, and Portales series have a horizon in which calcium carbonate has accumulated because of water leaching the soluble material to certain depths. At the same time, these soils have free lime throughout the profile because not enough water passes through them to leach out all of the free lime. Andrews County has mild winters and hot summers, and these contribute to the continuous decomposition of residue from plants and animals by micro-organisms, which results in a high organic-matter content in some soils. Examples are the Kimbrough and Stegall soils. High winds contributed to the development of soils in Andrews County by depositing parent materials that were subject to soil-building forces. An example is the Jalmar soils.

Plants and animals

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. They affect gains or losses in organic matter and plant nutrients. Structure and porosity are also affected by living organisms.

Plants have an important effect on soil formation in Andrews County. Most of the soils are low in organic-matter content because of the limited amount of vegetation. Organic matter is formed from decaying leaves and stems; hence, with the amount of vegetation limited, soils such as those of the Faskin and Douro series are low in organic matter. Earthworms and insects such as termites increase soil porosity by burrowing channels throughout the soil profile. Insects and plant roots increase water and air movement in the soil.

Relief

Relief, or slope, affects soil formation through its influence on runoff and drainage. Drainage in Andrews County is confined to areas surrounding the three mineralized salt lakes and along Monument and Seminole Draws. The county ranges from nearly level in the southeastern part to sloping and undulating in the western and northwestern parts.

Soils such as those of the Jalmar and Penwell series have little or no runoff because of their high rate of water intake. Potter and Blakeney soils, located along Monument and Seminole Draws, have relief that is sloping and nearly level to gently undulating. These soils are shallow over caliche, and soil material is removed from them by water erosion, retarding soil-forming processes.

Time

Time is an important phase of soil formation. The length of time that parent material has been in place is reflected in the degree of development of the soil profile.

Soils such as the Penwell show little development in the profile and are young soils. Soils such as the Douro and Faskin have well-defined horizons and are older soils.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their responses to

manipulation. First through classification, and then through use of soil maps, we can apply our knowledge to specific fields and other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in managing farms, fields, and range; in developing rural areas; in engineering work; and in many other ways. They are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 *(2)* and revised later *(4)*. The system currently used by the National Cooperative Soil Survey was developed in the early sixties and was adopted in 1965 *(6, 3).* It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly with respect to families, may change as more precise information becomes available.

Table 7 shows the classification of the soil series of Andrews County by family, subgroup, and order, according to the current system.

ORDER: Ten soil orders are recognized. They are Entisols, Alfisols, Inceptisols, Aridisols, Mollisols, Spodosols, Vertisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these orders are those that tend to produce broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. The four soil orders in Andrews County are Entisols, Aridisols, Vertisols, and Mollisols.

Entisols are recent soils that do not have genetic horizons or that have only the beginning of such horizons.

Aridisols are primarily soils of dry places. They do not have a sufficient accumulation of organic matter to be dark colored in the uppermost part.

Vertisols are soils in which natural churning or inversion of soil material takes place, primarily through the shrinking and swelling of clays.

Mollisols are soils that have a high base supply, a dark A horizon that is friable or soft, and a high organic-matter content.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that seem to have the greatest similarity in genesis. Suborders narrow the broad climatic ranges of soils in the orders. Soil properties used to separate suborders primarily reflect either the presence or lack of waterlogging or soil differences produced through the effects of climate or vegetation.

GREAT GROUP: Suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and other features. The horizons used as a basis for distinguishing between great groups are those in which (1) clay, iron, or humus has accumulated; (2) a pan has formed that interferes with growth of roots, movement of water, or both; or (3) a thick, dark-colored surface layer has formed. The other features commonly used are the self-mulching properties of clay, temperature of the soil, major differences in chemical composition (mainly the bases calcium, magnesium, sodium, and potassium), or the dark-red or dark-brown colors associated with soils formed in material weathered from basic rocks.

SUBGROUP: Great groups are divided into subgroups, one of which represents the central, or typic, segment of the group. Other subgroups have properties of the group but have also one or more properties of another great group, subgroup, or order. These are called intergrades. Subgroups may also be made for soils that have properties that intergrade outside the range of any other great group, suborder, or order.

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils used for engineering. Among the properties considered are texture, minerology, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES: The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

General Nature of the County

This section was prepared for those who desire general information about Andrews County. It briefly discusses the history and development, farming, geology, and climate.

History and Development

The Comanche Indians ruled this area of West Texas for more than 400 years. In 1865, Colonel Rufus Shafter led an exploration to the West Texas area. This marked the end of the Andrews County area as an Indian stronghold.

Andrews County was formed from Bexar County in August 1876 and was organized in 1910. It was named for Richard Andrews, a Texas revolutionary soldier and the first Texan killed in the war for independence from Mexico.

In 1890 the county had a population of 24, and by 1960 the number was 13,450. Andrews is the county seat.

The most important natural resources in the county are its soil, water, and oil. On the soils of the county, grasses are grown for grazing livestock, and cotton and grain sorghum are planted.

From the Ogallala Formation comes most of the ground water. Enough water is supplied for the city of Andrews by 19 wells north and northeast of the city. These wells have a daily capacity of 8,000,000 gallons, although the maximum daily demand has been only half that amount.

Oil was first discovered in the county in 1929. In May 1965, Andrews County produced its billionth barrel of crude oil. There are 196 oil and gas fields that produce some 60 million barrels of crude oil annually, along with 65 million cubic feet of natural gas.

Farming

Cattle ranching and dryland and irrigation farming are the chief farming enterprises in the county.

Cattle ranching is extensive and is the main type of farming. Livestock operations are primarily of the cow-calf type. Supplemental feeding is generally heavy, especially from December through March. Calves are often sold on a contract basis with delivery dates late in spring and early in summer. Most ranching operations are centered around the native grasses and forbs on range.

Cotton and grain sorghum are grown on medium-sized to large, fully mechanized farms. On these farms, raising livestock is a minor enterprise.

Geology

Andrews County is in one of the principal geological areas of Texas. Early in geological history, perhaps 250 million years ago, a mountain range extended from southwest to northwest across central Texas. In the northwest a shallow sea covered much of the State. This western area now is known as the Permian Basin.

This area covers middle western, north-central, western, and northwestern Texas, as well as parts of eastern New Mexico. The basin of this former sea dips downward to the west from the north-central part of Texas, with its low point in the vicinity of

Midland County, located southeast of Andrews County; then rises in elevation towards the northwest across Andrews County.

The material deposited during the Permian period is too deep to influence the soils of the county, but vast petroleum reservoirs are located in these ancient red-bed formations.

The uppermost geologic formation beneath the soils of Andrews County is the Ogallala Formation. The soils formed in eolian and water-laid parent material deposited on the surface of this formation. The parent material was deposited during the Pliocene epoch, was derived from older sedimentary rocks, and has passed through more than one cycle of weathering, erosion, and deposition. The material, commonly called Rocky Mountain outwash, consists of alkaline to calcareous, unconsolidated, sandy, clayey, and silty sediments, and the soils that formed in these sediments naturally have similar characteristics.

Climate

By Robert B. Orton, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

Andrews County has a cool-temperate, dry steppe climate characterized by mild winters. Table 8 gives temperature and precipitation data compiled from records kept at Andrews, Texas.

The average annual precipitation in the county is 13.89 inches. Approximately 84 percent of this amount falls during the warm season, April through October. Rains occur most frequently as the result of thunderstorms, and monthly and annual amounts are extremely variable. Periods when rainfall is scant for several months are not uncommon. Table 9 lists percentages of probability that specified amounts of precipitation will fall in 1-month periods at Andrews, Texas.

The prevailing winds in this area are southwesterly from November through March and southeasterly to south-southeasterly from May through September. Winds in October are southerly most of the time. The average annual wind speed is about 10.4 miles per hour. In this dry climate, the mean relative humidity at noon is estimated at 45 percent in January, 35 percent in April, 40 percent in July, and 40 percent in October. Andrews County receives approximately 70 percent of the total possible sunshine in winter, 73 percent in spring, 78 percent in summer, and 73 percent in the fall. In an average year, annual free-water (lake) evaporation exceeds precipitation by about 58 inches.

The winter season is marked by frequent surges of cold polar air accompanied by strong northerly winds and sharp drops in temperature. However, cold spells rarely last longer than 48 hours before sunshine and southwesterly winds bring rapid warming. Freezes occur on about three out of every four nights in winter. Precipitation is light and most often falls as snow. Moisture received from snow is rarely distributed uniformly because the snow usually piles up in drifts.

Spring weather is characterized by frequent and rather abrupt changes. Through March and April, warm and cold spells follow each other in rapid succession. These are the windiest months of the year. Infrequently, persistently strong southwesterly to northwesterly winds produce duststorms in the area. Thunderstorms, which rarely occur in winter, increase in number through spring and occur on about 6 days in May.

Thunderstorm activity reaches its peak in summer, when storms occur on about 6 or 7 days of each month. Daily high temperature usually exceeds 90° during the summer months, and the daily low is most often in the upper sixties.

Fall weather, like that of summer, is very pleasant, but fall has greater variety because polar air masses return and bring changes. Rainfall decreases progressively from September through November. Mild sunny days and clear cool nights characterize the fall season.

The warm season (freeze-free period) in Andrews County averages 213 days. The average dates of the last occurrence of a temperature of 32° F. or below in spring and the first occurrence in fall are April 6 and November 5, respectively.

Literature Cited

(1) American Association of State Highway Officials. 1971. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 v., illus. Washington, D.C.

(2) Baldwin, Mark, Kellogg, Charles E., and Thorp, James. 1938. Soil classification. Soils and Men, U.S. Dept. Agr. Ybk: 979-1001.

(3) Simonson, Roy W. 1962. Soil classification in The United States. Sci. 137: 1027-1034.

(4) Thorp, James and Smith, Guy D. 1949. Higher categories of soil classification: order, suborder, and great soil groups. Soil Sci. 67: 117-126.

(5) United States Department of Agriculture. 1951. Soil Survey Manual. Agr. Handbook No. 18, 503 pp., illus.

(6)— 1960. Soil classification a Comprehensive System, 7TH Approximation. 265 pp., illus. [Supplements issued in March 1967 and September 1968]

(7) United States Department of Defense. 1968. Unified Soil Classification for roads, airfields, embankments and foundations. MIL-STD-619B, 30 pp., illus.

Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. An excavation produced by wind action in loose soil, usually sand.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeters in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Coarse fragments. Mineral or rock particles more than 2 millimeters in diameter.

Coarse-textured soils. Sand and loamy sand.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.-—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Fine-textured soils. Sandy clay, silty clay, and clay. Roughly, soil that contains 35 percent or more of clay.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity, or capillary capacity.*

Gypsum. Calcium sulphate.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A *horizon.*—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active, and therefore it is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, medium, rapid,* and *very rapid.*

Medium-textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil composed mainly of inorganic (mineral) material and low in content of organic material. Its bulk density is greater than that of organic soil.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind of climax vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure *are—platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Tables

The tables in this soil survey contain information that affects land use planning in this survey area. More current data tables may be available from the Web Soil Survey at the Tabular Data tab.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soils	Acres	Percent	Soils	Acres	Percent
Blakeney and Conger soils, gently undulating	27, 111	2. 8	Portales clay loam	1, 152	0. 1
Dune land	3, 313	. 3	Potter soils, sloping	1, 386	. 1
Faskin and Douro soils, gently undulating	154, 603	16. 0	Ratliff soils, gently undulating	52, 746	5. 5
Ima loamy fine sand, 0 to 3 percent slopes	9, 951	1. 0	Stegall and Slaughter soils	6, 332	. 7
Jalmar-Penwell association, undulating	342, 769	35. 7	Triomas loamy fine sand, 0 to 3 percent slopes	4, 589	. 5
Kimbrough soils, gently undulating	59, 182	6. 2	Triomas and Wickett soils, gently undulating	227, 248	28. 9
Kimbrough-Slaughter complex, 0 to 3 percent slopes	12, 510	1. 2	Salt lakes	2, 247	. 2
Krade soils, undulating	5, 541	. 6			
Lipan clay	1, 880	. 2	Total	962, 560	100. 0

TABLE 2.—*Predicted average acre yields of principal crops*

[Dashes indicate that crop is not grown on this soil or is not suited to it]

Soi	Cotton (lint)		Grain sorghum	
	Dryland	Irrigated	Dryland	Irrigated
	Lb.	*Lb.*	*Lb.*	*Lb.*
Blakeney and Conger soils, gently undulating	----------	385	----------	2, 700
Dune land	----------	----------	----------	----------
Faskin and Douro soils, gently undulating	150	585	1, 125	3, 800
Ima loamy fine sand, 0 to 3 percent slopes	----------	425	----------	2, 600
Jalmar-Penwell association, undulating (Jalmar part)	----------	250	----------	2, 000
Kimbrough soils, gently undulating	----------	----------	----------	----------
Kimbrough-Slaughter complex, 0 to 3 percent slopes	----------	----------	----------	----------
Krade soils, undulating	----------	----------	----------	----------
Lipan clay	----------	----------	----------	----------
Portales clay loam	150	550	1, 200	3, 800
Potter soils, sloping	----------	----------	----------	----------
Ratliff soils, gently undulating	----------	500	----------	2, 700
Stegall and Slaughter soils	125	400	875	3, 000
Triomas loamy fine sand, 0 to 3 percent slopes	----------	450	----------	3, 000
Triomas and Wickett soils, gently undulating	----------	450	----------	3, 000

TABLE 3.—*Estimates of soil properties significant in engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. These soils may have different properties and limitations, therefore it is necessary to follow carefully the instructions for referring to other series that appear in the first column. The symbol > means greater than. The symbol < means less than]

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO	Percentage passing sieve—No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Shrink-swell potential
		Inches	*Inches*								*Inches per hour*	*Inches per inch of soil*	*pH*	
*Blakeney: BCB. For the Conger part of unit BCB, see the Conger series.	B	12-20	0-18	Fine sandy loam	SM, ML	A-4	-----	100	70-85	40-55	2.0-6.3	0.08-0.12	7.9-8.4	Low.
			18-32	Strongly cemented rounded caliche.										
			32-68	Weakly cemented caliche.										
Conger. Mapped only in an undifferentiated unit with Blakeney soils.	B	12-20	0-6	Loam	ML-CL	A-4, A-6	-----	100	85-95	60-75	0.63-2.0	0.10-0.15	7.9-8.4	Low.
			6-17	Clay loam	CL	A-6	-----	100	85-95	60-75	0.63-2.0	0.14-0.18	7.9-8.4	Low.
			17-39	Caliche plates, strongly cemented.										
			39-75	Weakly cemented caliche.										
Douro. Mapped only in an undifferentiated unit with Faskin soils.	B	20-40	0-9	Fine sandy loam	SM, ML	A-4	-----	100	70-85	40-55	2.0-6.3	0.08-0.12	6.6-7.8	Low.
			9-30	Sandy clay loam	SC, CL	A-6	-----	100	80-90	35-55	0.63-2.0	0.12-0.16	6.6-7.8	Low.
			30-51	Platy caliche, indurated.										
			51-75	Weakly cemented caliche.										
Dune land: DU; Materials are too variable to be rated.														
*Faskin: FDB. For the Douro part of unit FDB, see the Douro series.	B	>60	0-8	Fine sandy loam	SM, ML	A-4	-----	100	70-95	40-60	2.0-6.3	0.05-0.10	6.6-7.3	Low.
			8-42	Sandy clay loam	SC, CL, ML-CL	A-6	-----	100	80-90	40-70	0.63-2.0	0.10-0.15	6.6-8.4	Low.
			42-80	Sandy clay loam	SC, CL, ML-CL	A-6	-----	100	80-90	40-70	0.63-2.0	0.10-0.15	6.6-8.4	Low.
Ima: ImB	B	>60	0-14	Loamy fine sand	SM	A-2	-----	100	75-90	25-35	2.0-6.3	0.05-0.10	7.4-7.8	Low.
			14-44	Fine sandy loam	SM	A-4 or A-2	-----	100	75-90	30-50	2.0-6.3	0.05-0.10	7.9-8.4	Low.
			44-84	Sandy clay loam	SC, CL	A-6	-----	100	80-90	35-55	0.63-2.0	0.10-0.15	7.9-8.4	Low.
*Jalmar: JPC. For the Penwell part of unit JPC, see the Penwell series.	A	>60	0-26	Fine sand	SP-SM, SM	A-2-4	-----	100	65-99	10-20	6.3-20.0	0.03-0.07	6.6-7.3	Low.
			26-64	Sandy clay loam	SC, SM-SC	A-2-6, A-2-4	-----	100	80-98	26-35	0.63-2.0	0.13-0.16	6.6-7.8	Low.
			64-80	Sandy clay loam	SC, SM-SC	A-2-6, A-2-4	-----	100	80-98	25-35	0.63-2.0	0.13-0.16	7.9-8.4	Low.
*Kimbrough: KaB, KMB. For the Slaughter part of unit KaB, see Slaughter series.	C	4-10	0-8	Loam	CL	A-4	90-100	90-100	80-95	60-70	0.63-2.0	0.13-0.15	6.6-8.4	Low.
			8-31	Indurated caliche plates.										
			31-54	Strongly cemented caliche plates.										
Krade: KRC	B	>60	0-80	Fine sandy loam	SM, ML, ML-CL	A-4	-----	100	70-90	40-70	2.0-6.3	0.08-0.12	7.9-8.4	Low.
Lipan: Lc	D	>60	0-60	Clay	CH	A-7	-----	100	95-100	85-95	<0.06	0.15-0.20	7.4-8.4	High.
Penwell. Mapped only in an association with Jalmar soils.	A	>60	0-85	Fine sand	SM, SP-SM, SP	A-2-4	-----	100	70-100	2-15	6.3-20.0	0.03-0.07	6.6-7.3	Low.
Portales: Po	B	>60	0-88	Clay loam	CL	A-6 or A-7	-----	100	90-100	60-75	0.63-2.0	0.13-0.15	7.9-8.4	Low.
Potter: PTC	C	4-10	0-5	Loam	ML, CL	A-6, A-4	80-95	70-90	60-85	51-70	0.63-2.0	0.12-0.16	7.9-8.4	Low.
			5-36	Platy and slightly platy caliche	GM, GC, SM, SC	A-2, A-4, A-6	30-80	25-75	20-60	12-50	0.63-2.0	<0.02	7.9-8.4	Low.
Ratliff: RAB	B	>60	0-10	Loam	ML-CL, CL, SC	A-4, A-6	-----	100	85-95	40-60	0.63-2.0	0.10-0.15	7.9-8.4	Low.
			10-80	Clay loam	CL, ML-CL	A-6	100	95-100	90-95	50-70	0.63-2.0	0.12-0.15	7.9-8.4	Low.
Slaughter. Mapped only in a complex with Kimbrough soils and an undifferentiated unit with Stegall soils.	C	10-20	0-16	Clay loam	CL, ML-CL	A-6, A-7-6	-----	100	90-95	70-80	0.20-0.63	0.15-0.19	6.6-7.3	Moderate.
			16-30	Indurated caliche plates.										

TABLE 3.—*Estimates of soil properties significant in engineering*—Continued

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO	Percentage passing sieve—No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.	Permeability	Available water capacity	Reaction	Shrink-swell potential
		Inches	*Inches*								*Inches per hour*	*Inches per inch of soil*	*pH*	
*Stegall: SsA. For the Slaughter part of unit SsA, see the Slaughter series.	C	24-36	0-24	Clay loam	CL, ML-CL	A-6, A-7-6	-----	100	90-100	70-80	0.20-0.63	0.16-0.20	6.6-8.4	Low.
			24-29	Clay loam	CL, ML-CL	A-6, A-7-6	-----	100	90-100	70-90	0.20-0.63	0.16-0.20	6.6-8.4	Moderate.
			29-40	Indurated caliche plates.										
*Triomas: TWB, TrB. For the Wickett part of unit TWB, see the Wickett series.	B	>60	0-16	Fine sand	SP-SM, SM	A-2-4	-----	100	65-98	10-20	6.30-20.0	0.03-0.07	6.6-7.3	Low.
			16-68	Sandy clay loam	SC, SM-SC	A-2-6, A-2-4	-----	100	80-99	26-35	0.63-2.0	0.12-0.16	6.6-7.8	Low.
			68-80	Sandy clay loam	SC, SM-SC	A-2-6, A-2-4	-----	100	80-95	26-35	0.63-2.0	0.12-0.16	7.9-8.4	Low.
Wickett. Mapped only in an undifferentiated unit with Triomas soils.	C	20-40	0-16	Loamy fine sand	SM	A-2-4	100	98-100	90-95	20-25	2.0-6.3	0.08-0.10	6.6-7.8	Low.
			16-33	Fine sandy loam	SM, SM-SC	A-4, A-2-4	100	98-100	90-98	25-40	2.0-6.3	0.11-0.14	7.4-7.8	Low.
			33-53	Indurated platy caliche.										
			53-67	Weakly cemented caliche.										

TABLE 4.—*Engineering interpretations of the soils*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. These soils may have different properties and limitations, therefore it is necessary to follow carefully the instructions for referring to other series that appear in the first column]

Soil series and map symbols	Suitability as source of— Topsoil	Suitability as source of— Road subgrade	Degree of limitations and soil features affecting— Highway location	Degree of limitations and soil features affecting— Foundations for low buildings	Degree of limitations and soil features affecting— Septic tank filter fields	Degree of limitations and soil features affecting—Continued Sewage lagoons	Recreation areas: Camp areas	Recreation areas: Picnic areas	Recreation areas: Playgrounds	Recreation areas: Paths and trails	Soil features affecting irrigation	Corrosivity rating of soil for uncoated steel
*Blakeney: BCB. For the Conger part of unit BCB, see the Conger series.	Fair: 12 to 20 inches of fine sandy loam.	Poor: 12 to 20 inches of material.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Moderate: dust hazard.	Moderate: dust hazard.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Moderate: dust hazard.	Strongly cemented caliche at a depth of 12 to 20 inches.	Low.
Conger. Mapped only in an undifferentiated unit with Blakeney soils.	Poor: 4 to 6 inches of loam.	Poor: 12 to 20 inches of material.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Moderate: dust hazard.	Moderate: dust hazard.	Severe: strongly cemented caliche at a depth of 12 to 20 inches.	Moderate: dust hazard.	Strongly cemented caliche at a depth of 12 to 20 inches.	Moderate: clay loam texture.
Douro. Mapped only in an undifferentiated unit with Faskin soils.	Fair: 7 to 12 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.	Severe: platy caliche, indurated at a depth of 20 to 40 inches.	Severe: platy caliche, indurated at a depth of 20 to 40 inches.	Slight.	Slight.	Moderate: platy caliche, indurated at a depth of 20 to 40 inches.	Slight.	Platy caliche, indurated at a depth of 20 to 40 inches.	Moderate: sandy clay loam texture.
Dune land: DU. Soil properties are too variable to be rated.												
*Faskin: FDB. For the Douro part of unit FDB, see the Douro series.	Fair: fine sandy loam at a depth of 7 to 12 inches.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.	Slight.	Moderate: moderate permeability.	Slight.	Slight.	Slight.	Slight.	All features favorable.	Moderate: sandy clay loam texture.
Ima: ImB.	Poor: loamy fine sand texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.	Slight.	Severe: moderately rapid permeability, calcareous.	Severe: loamy fine sand texture.	Severe: loamy fine sand texture.	Severe: loamy fine sand texture.	Severe: loamy fine sand texture.	Loamy fine sand texture; moderately rapid permeability.	Moderate: sandy clay loam texture; conductivity.

490-295—74——3

TABLE 4.—*Engineering interpretations of the soils*—Continued

Soil series and map symbols	Suitability as source of— Topsoil	Suitability as source of— Road subgrade	Degree of limitations and soil features affecting— Highway location	Degree of limitations and soil features affecting— Foundations for low buildings	Degree of limitations and soil features affecting— Septic tank filter fields	Degree of limitations and soil features affecting—Continued Sewage lagoons	Recreation areas: Camp areas	Recreation areas: Picnic areas	Recreation areas: Playgrounds	Recreation areas: Paths and trails	Soil features affecting irrigation	Corrosivity rating of soil for uncoated steel
*Jalmar: JPC. For the Penwell part of unit JPC, see the Penwell series.	Poor: fine sand texture.	Good.	Slight.	Slight.	Slight.	Moderate: moderate permeability.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Rapid intake rate; erodible.	Moderate: sandy clay loam texture.
*Kimbrough: KsB, KMB. For the Slaughter part of unit KsB, see the Slaughter series.	Poor where 4 to 6 inches of loam, 10 to 12 percent fragments. Fair where 6 to 10 inches of loam, 3 to 10 percent fragments.	Poor: 4 to 10 inches of suitable material.	Severe: indurated caliche plates at a depth of 4 to 10 inches.	Severe: indurated caliche plates at a depth of 4 to 10 inches.	Severe: indurated caliche plates at a depth of 4 to 10 inches.	Severe: indurated caliche plates at a depth of 4 to 10 inches.	Slight.	Slight.	Severe: indurated caliche plates at a depth of 4 to 10 inches.	Slight.	Indurated caliche plates at a depth of 4 to 10 inches.	High: conductivity.
Kreda: KRC.	Good.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.	Slight.	Severe: moderately rapid permeability.	Moderate: dust hazard.	Moderate: dust hazard.	Moderate where slopes are 0 to 2 percent: dust hazard. Severe where slopes are 2 to 5 percent: dust hazard.	Moderate: dust hazard.	Slopes; calcareous soils.	Low.
Lipan: Lc.	Poor: clay texture.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight.	Severe: very slow permeability; clay texture.	Severe: clay texture.	Severe: very slow permeability; clay texture.	Severe: clay texture.	Slow intake rate; flooding.	High: clay texture.
Penwell. Mapped only in an association with Jalmar soils.	Poor: fine sand texture.	Good.	Slight where slopes are 0 to 6 percent; moderate where slopes are 6 to 8 percent.	Slight where slopes are 0 to 6 percent; moderate where slopes are 6 to 8 percent.	Severe: inadequate filtration.	Severe: rapid permeability.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	High intake rate; low available water capacity; dune topography; erodible.	Low.
Portales: Po.	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.	Slight.	Moderate: moderate permeability.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	All features favorable.	Moderate: conductivity; clay loam texture.
Potter: PTC.	Poor: 10 to 15 percent coarse fragments.	Poor: 4 to 10 inches of suitable material.	Severe: platy caliche at a depth of 4 to 10 inches.	Severe: platy caliche at a depth of 4 to 10 inches.	Severe: platy caliche at a depth of 4 to 10 inches.	Severe: permeable, calcareous substratum; platy caliche at a depth of 4 to 10 inches.	Slight.	Slight.	Severe: platy caliche at a depth of 4 to 10 inches.	Slight.	Platy caliche at a depth of 4 to 10 inches.	Moderate: conductivity.
Ratliff: RAB.	Fair: 8 to 10 inches of loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.	Slight.	Moderate: moderate permeability.	Moderate: dust hazard.	Moderate: dust hazard.	Moderate: dust hazard.	Moderate: dust hazard.	All features favorable.	Moderate: clay loam texture.
Slaughter. Mapped in an undifferentiated unit with Stegall soils and in a complex with Kimbrough soils.	Fair: clay loam texture.	Poor: 10 to 20 inches of suitable material.	Severe: indurated platy caliche at a depth of 10 to 20 inches.	Severe: indurated platy caliche at a depth of 10 to 20 inches.	Severe: indurated platy caliche at a depth of 10 to 20 inches.	Severe: indurated platy caliche at a depth of 10 to 20 inches.	Moderate: moderately slow permeability; clay loam texture.	Moderate: clay loam texture.	Severe: indurated platy caliche at a depth of 10 to 20 inches.	Moderate: clay loam texture.	Indurated platy caliche at a depth of 10 to 20 inches.	Moderate: clay loam texture.

TABLE 4.—*Engineering interpretations of the soils*—Continued

Soil series and map symbols	Suitability as source of— Topsoil	Suitability as source of— Road subgrade	Degree of limitations and soil features affecting— Highway location	Degree of limitations and soil features affecting— Foundations for low buildings	Degree of limitations and soil features affecting— Septic tank filter fields	Degree of limitations and soil features affecting—Continued Sewage lagoons	Recreation areas: Camp areas	Recreation areas: Picnic areas	Recreation areas: Playgrounds	Recreation areas: Paths and trails	Soil features affecting irrigation	Corrosivity rating of soil for uncoated steel
*Stegall: SsA. For Slaughter part of unit SsA, see the Slaughter series.	Fair: clay loam texture.	Fair: 24 to 36 inches of suitable material.	Severe: indurated caliche plates at a depth of 24 to 36 inches.	Moderate: moderate shrink-swell potential.	Moderate: indurated caliche plates at a depth of 24 to 36 inches.	Severe: indurated caliche plates at a depth of 24 to 36 inches.	Moderate: moderately slow permeability; clay loam texture.	Moderate: clay loam texture.	Moderate: moderately slow permeability; indurated caliche plates at a depth of 24 to 36 inches.	Moderate: clay loam texture.	Indurated caliche plates at a depth of 24 to 38 inches.	Moderate: clay loam texture.
*Triomas: TWB, TrB. For the Wickett part of unit TWB, see the Wickett series.	Poor: fine sand texture.	Good.	Slight.	Slight.	Moderate: moderate permeability.	Moderate: moderate permeability.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Rapid intake rate; erodible.	Moderate: sandy clay loam texture.
Wickett. Mapped only in an undifferentiated unit with Triomas soils.	Poor: loamy fine sand texture.	Fair where 24 to 40 inches of suitable material; poor where 20 to 24 inches of suitable material.	Severe where indurated caliche is at a depth of 20 to 36 inches; moderate where indurated platy caliche is at a depth of 36 to 40 inches.	Slight.	Severe: indurated platy caliche at a depth of 20 to 40 inches.	Severe: indurated platy caliche at a depth of 20 to 40 inches; moderately rapid permeability.	Moderate: loamy fine sand texture.	Moderate: loamy fine sand texture.	Moderate: indurated platy caliche at a depth of 20 to 40 inches; loamy fine sand texture.	Moderate: loamy fine sand texture.	Rapid intake rate; erodible.	Low.

TABLE 5.—*Engineering test data*

[Tests performed by Texas Highway Department]

Soil name and location	Parent material	Report No.	Depth from surface	Shrinkage limit	Linear shrinkage	Shrinkage ratio	Percentage passing sieve—[1]			Liquid limit	Plasticity index	Classification	
							No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)			AASHO	Unified
			Inches	*Percent*	*Percent*								
Jalmar fine sand in an area of Jalmar-Penwell association, undulating: 800 feet west, then 10 feet north of the northeast corner of sec. 3, block A 50, public school land. In range on north side of oil field road. (modal).	Eolian sandy sediments.	68-332-R	0-10	18	0	1.76	100	97	13	21	3	A-2-4(0)	SM
		68-333-R	10-24	18	1.1	1.71	100	99	13	19	2	A-2-4(0)	SM
		68-334-R	24-56	17	4.7	1.80	100	98	31	26	13	A-2-6(0)	SC
		68-335-R	56-78	18	2.9	1.76	100	98	27	23	7	A-2-4(0)	SM-SC
Penwell fine sand in an area of Jalmar-Penwell association, undulating: 4,800 feet west and 300 feet south of northeast corner sec. 25, block 11, university land. On west side of Farm Road 181 in range. (modal).	Noncalcareous eolian sands.	68-342-R	0-12	18	.3	1.71	----------	100	6	20	3	A-2-4(0)	SP-SM
		68-343-R	12-64	19	0	1.70	----------	100	2	22	3	A-2-4(0)	SP
Triomas fine sand in an area of Triomas and Wickett soils, gently undulating: 800 feet west of the northeast corner of sec. 2, block A 49, public school land. In range east of ranch road. (modal).	Eolian sandy sediments.	68-328-R	0-17	18	.8	1.75	100	98	12	21	3	A-2-4(0)	SP-SM
		68-329-R	17-34	18	3.7	1.77	100	99	29	24	9	A-2-4(0)	SC
		68-330-R	34-54	17	4.5	1.77	100	97	29	26	12	A-2-4(0)	SC
		68-331-R	54-68	18	4.4	1.77	100	96	27	26	11	A-2-6(0)	SC

[1] Mechanical analyses according to the AASHO Designation T88-57 (*1*). Results by this procedure differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

TABLE 6.—*Suitability of soils for wildlife habitat elements and for kinds of wildlife*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. These soils may have different properties and limitations, therefore it is necessary to follow carefully the instructions for referring to other series that appear in the first column]

Soil series and map symbols	Wildlife habitat elements			Wildlife habitat elements—Continued			Kinds of wildlife		
	Grain and seed crops	Grass and legumes	Wild herbaceous upland plants	Hardwood trees and shrubs	Wetland food and cover plants	Shallow water developments	Openland	Brushland	Wetland
*Blakeney: BCB For the Conger part of unit BCB, see the Conger series.	Poorly suited	Poorly suited	Suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Conger Mapped only in an undifferentiated unit with Blakeney soils.	Poorly suited	Poorly suited	Suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Douro Mapped only in an undifferentiated unit with Faskin soils.	Suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Dune land: DU	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited	Poorly suited	Unsuited	Unsuited.
*Faskin: FDB For the Douro part of unit FDB, see the Douro series.	Well suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Ima: ImB	Poorly suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
*Jalmar: JPC For the Penwell part of unit JPC, see the Penwell series.	Poorly suited	Suited	Poorly suited	Unsuited	Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
*Kimbrough: KaB, KMB For the Slaughter part of unit KaB, see the Slaughter series.	Unsuited	Unsuited	Poorly suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Krade: KRC	Poorly suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
Lipan: Lc	Poorly suited	Poorly suited	Suited	Unsuited	Poorly suited	Poorly suited	Poorly suited	Poorly suited	Suited.
Penwell Mapped only in an association with Jalmar soils.	Poorly suited	Suited	Poorly suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Portales: Pe	Well suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Potter: PTC	Unsuited	Unsuited	Poorly suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Ratliff: RAB	Poorly suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Slaughter Mapped in an undifferentiated unit with Stegall soils and in a complex with Kimbrough soils.	Poorly suited	Poorly suited	Suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
*Stegall: SsA For the Slaughter part of unit SsA, see the Slaughter series.	Well suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
*Triomas: TrB, TWB For the Wickett part of unit TWB, see the Wickett series.	Poorly suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
Wickett Mapped only in an undifferentiated unit with Triomas soils.	Poorly suited	Well suited	Well suited	Unsuited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.

TABLE 7.—*Classification of soil series*

Soil series	Family	Subgroup	Order
Blakeney	Loamy, mixed, thermic, shallow	Ustochreptic Paleorthids	Aridisols.
Conger	Loamy, mixed, thermic, shallow	Ustollic Paleorthids	Aridisols.
Douro	Fine-loamy, mixed, thermic	Petrocalcic Ustalfic Paleargids	Aridisols.
Faskin	Fine-loamy, mixed, thermic	Ustalfic Haplargids	Aridisols.
Ima	Coarse-loamy, mixed, thermic	Ustochreptic Camborthids	Aridisols.
Jalmar	Loamy, mixed, thermic	Arenic Ustalfic Haplargids	Aridisols.
Kimbrough	Loamy, mixed, thermic, shallow	Petrocalcic Calciustolls	Mollisols.
Krade	Coarse-loamy, mixed (calcareous), thermic	Ustic Torriorthents	Entisols.
Lipan	Fine, montmorillonitic, thermic	Entic Pellusterts	Vertisols.
Penwell	Mixed, thermic	Ustic Torripsamments	Entisols.
Portales	Fine-loamy, mixed, thermic	Aridic Calciustolls	Mollisols.
Potter	Loamy, carbonatic, thermic, shallow	Ustollic Calciorthids	Aridisols.
Ratliff	Fine-loamy, mixed, thermic	Ustollic Calciorthids	Aridisols.
Slaughter	Clayey, mixed, thermic, shallow	Petrocalcic Paleustolls	Mollisols.
Stegall	Fine, mixed, thermic	Petrocalcic Paleustolls	Mollisols.
Triomas	Fine-loamy, mixed, thermic	Ustalfic Haplargids	Aridisols.
Wickett	Coarse-loamy, mixed, thermic	Petrocalcic Ustalfic Paleargids	Aridisols.

TABLE 8.—*Temperature and precipitation data*

[Data compiled from records at Andrews, Tex., elevation 3,172 feet. Temperature data for period 1962–69, precipitation for 1949–69]

Month	Temperature				Precipitation					
	Average daily maximum	Average monthly maximum	Average daily minimum	Average monthly minimum	Average monthly total	Average number of days with—			Snow, sleet	
						0.1 inch or more	0.5 inch or more	1 inch or more	Average monthly total	Maximum monthly
	°F.	°F.	°F.	°F.	*Inches*				*Inches*	*Inches*
January	59.3	75.6	29.5	10.4	0.61	1	(1)	0	1.0	4.0
February	60.0	74.9	30.6	15.7	.43	1	(1)	0	.6	2.8
March	69.1	85.3	38.6	20.0	.48	1	(1)	(1)	(2)	(2)
April	80.1	90.9	50.6	38.6	.74	2	1	(1)	0	0
May	87.1	99.9	58.1	45.4	1.78	3	1	(1)	0	0
June	93.2	100.9	65.8	55.4	1.36	3	1	(1)	0	0
July	95.5	102.0	68.6	61.4	2.37	4	2	1	0	0
August	93.3	102.1	67.1	59.1	1.62	4	1	1	0	0
September	85.8	96.0	60.9	47.6	2.19	3	2	1	0	0
October	78.9	92.4	50.1	37.5	1.60	2	1	(1)	0	0
November	67.8	81.3	40.9	25.0	.41	1	(1)	0	(2)	(2)
December	58.6	75.0	31.4	17.1	.30	1	(1)	0	.5	4.0
Year	77.4	89.7	49.4	36.1	13.89	26	9	3	2.1	4.0

[1] Less than one-half day.
[2] Trace, an amount too small to measure.

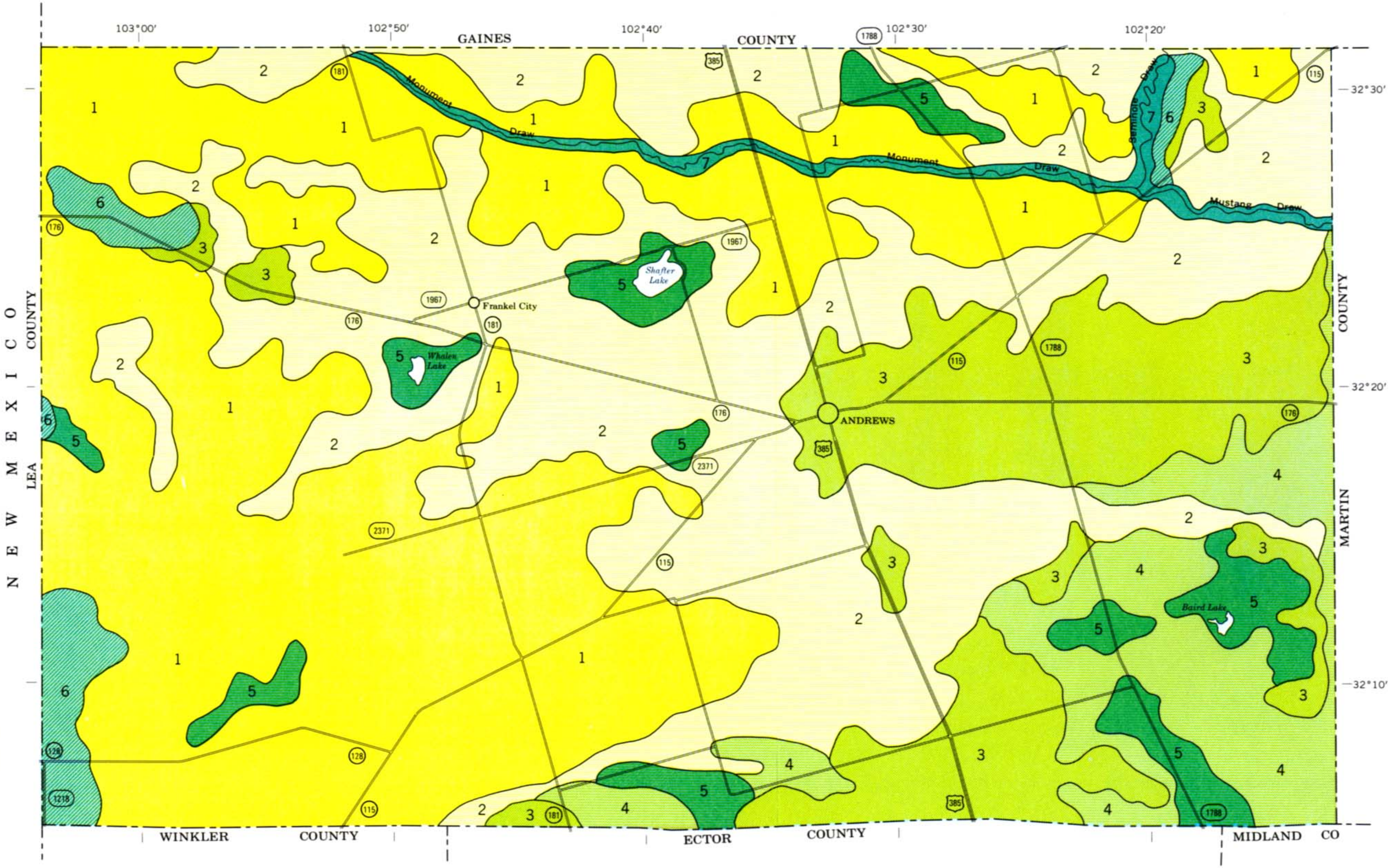
TABLE 9.—*Probabilities of receiving selected amounts of precipitation*

[Data recorded at Andrews, Tex., for period 1949–69. The symbol < means less than]

Month	Probability of receiving during month—							
	Trace or less	0.5 inch or more	1 inch or more	2 inches or more	3 inches or more	4 inches or more	5 inches or more	6 inches or more
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
January	6	45	23	10	2	1	<1	<1
February	15	40	18	4	1	<1	<1	<1
March	17	30	10	4	1	<1	<1	<1
April	5	50	30	10	3	2	<1	<1
May	<1	80	60	40	20	12	8	5
June	<1	80	58	30	19	8	5	3
July	5	85	70	40	21	11	6	3
August	1	80	60	32	12	7	3	2
September	1	72	54	33	20	12	7	3
October	4	80	80	32	15	8	4	2
November	23	35	15	3	1	<1	<1	<1
December	11	46	24	5	1	<1	<1	<1

NRCS Accessibility Statement

The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at helpdesk@helpdesk.itc.nrcs.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.



SOIL ASSOCIATIONS *

1 Jalmar-Penwell association: Deep, moderately permeable to rapidly permeable fine sands

2 Triomas-Wickett association: Deep and moderately deep, moderately permeable to moderately rapidly permeable fine sands and loamy fine sands

3 Faskin-Douro association: Deep and moderately deep, moderately permeable fine sandy loams

4 Kimbrough-Slaughter-Stegall association: Very shallow to moderately deep, moderately permeable to moderately slowly permeable loams and clay loams

5 Ratliff association: Deep, moderately permeable loams

6 Blakeney-Conger association: Shallow, moderately rapidly permeable to moderately permeable fine sandy loams and loams

7 Ima-Potter-Portales association: Deep to very shallow, moderately rapidly permeable to moderately permeable loamy fine sands, loams, and clay loams

* Texture refers to the surface layer of the major soils in each association. Very shallow, shallow, and moderately deep refer to the depth of soils over caliche.

Compiled 1972

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

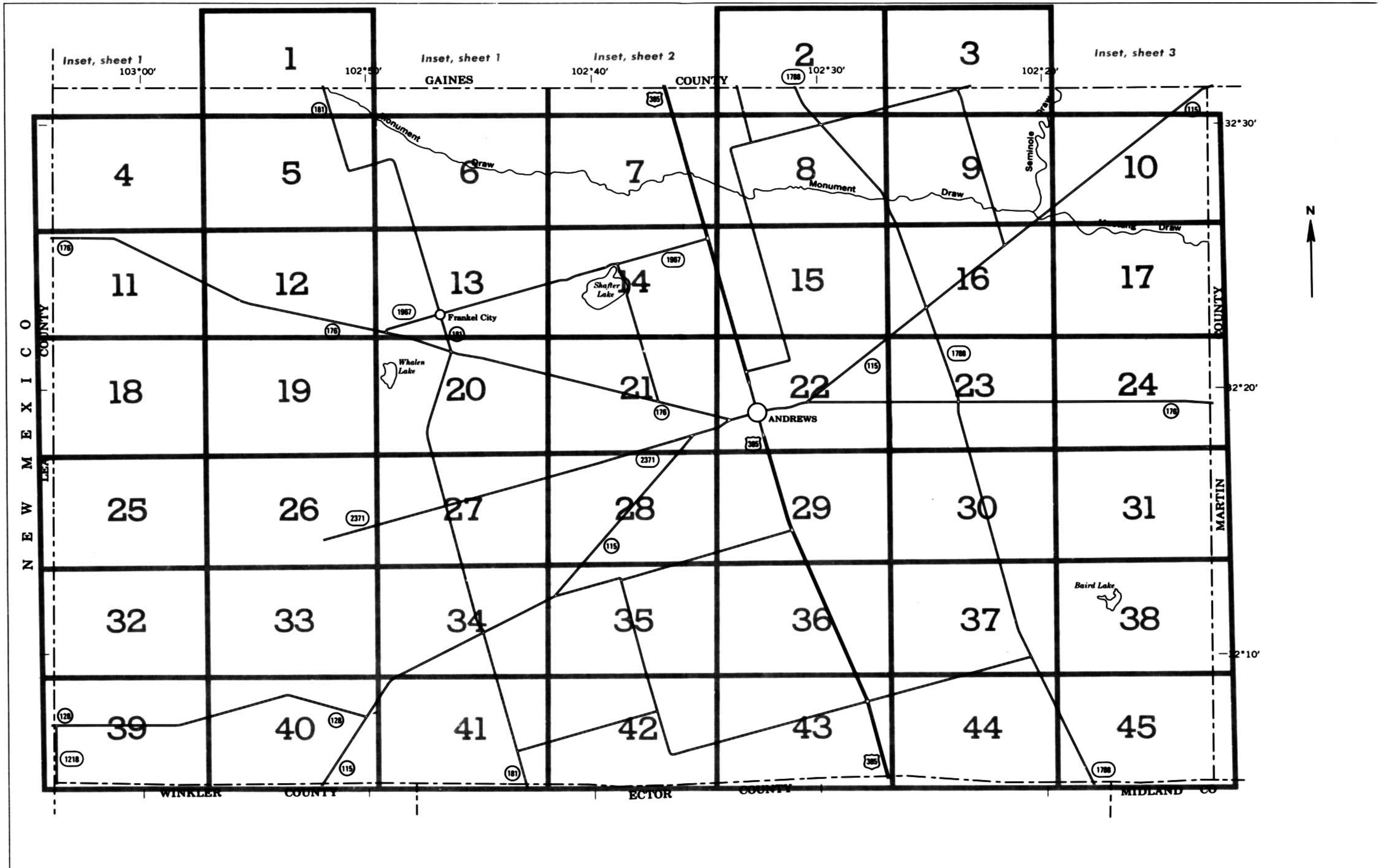
TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

ANDREWS COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles



INDEX TO MAP SHEETS

ANDREWS COUNTY, TEXAS

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, and C shows the slope. Most symbols without a slope letter are those of nearly level soils, but one is for Dune land, which has considerable range in slope. (W) following the soil name indicates that erosion, especially that caused by blowing, is evident in places, but the degree cannot be estimated reliably.

SYMBOL	NAME
	Medium Intensity
ImB	Ima loamy fine sand, 0 to 3 percent slopes (W)
KsB	Kimbrough-Slaughter complex, 0 to 3 percent slopes
Lc	Lipan clay
Po	Portales clay loam
SsA	Stegall and Slaughter soils
TrB	Triomas loamy fine sand, 0 to 3 percent slopes (W)
	Low Intensity *
BCB	Blakeney and Conger soils, gently undulating
DU	Dune land
FDB	Faskin and Douro soils, gently undulating
JPC	Jalmar-Penwell association, undulating (W)
KMB	Kimbrough soils, gently undulating
KRC	Krade soils, undulating
PTC	Potter soils, sloping
RAB	Ratliff soils, gently undulating
TWB	Triomas and Wickett soils, gently undulating (W)

* The composition of these units is more variable than that of the other units in the county but has been controlled well enough to interpret for the expected use of the soils.

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Caliche pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Unclassified

Canals and ditches

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

Soil boundary and symbol (Dx)

Gravel

Stoniness
- Stony
- Very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

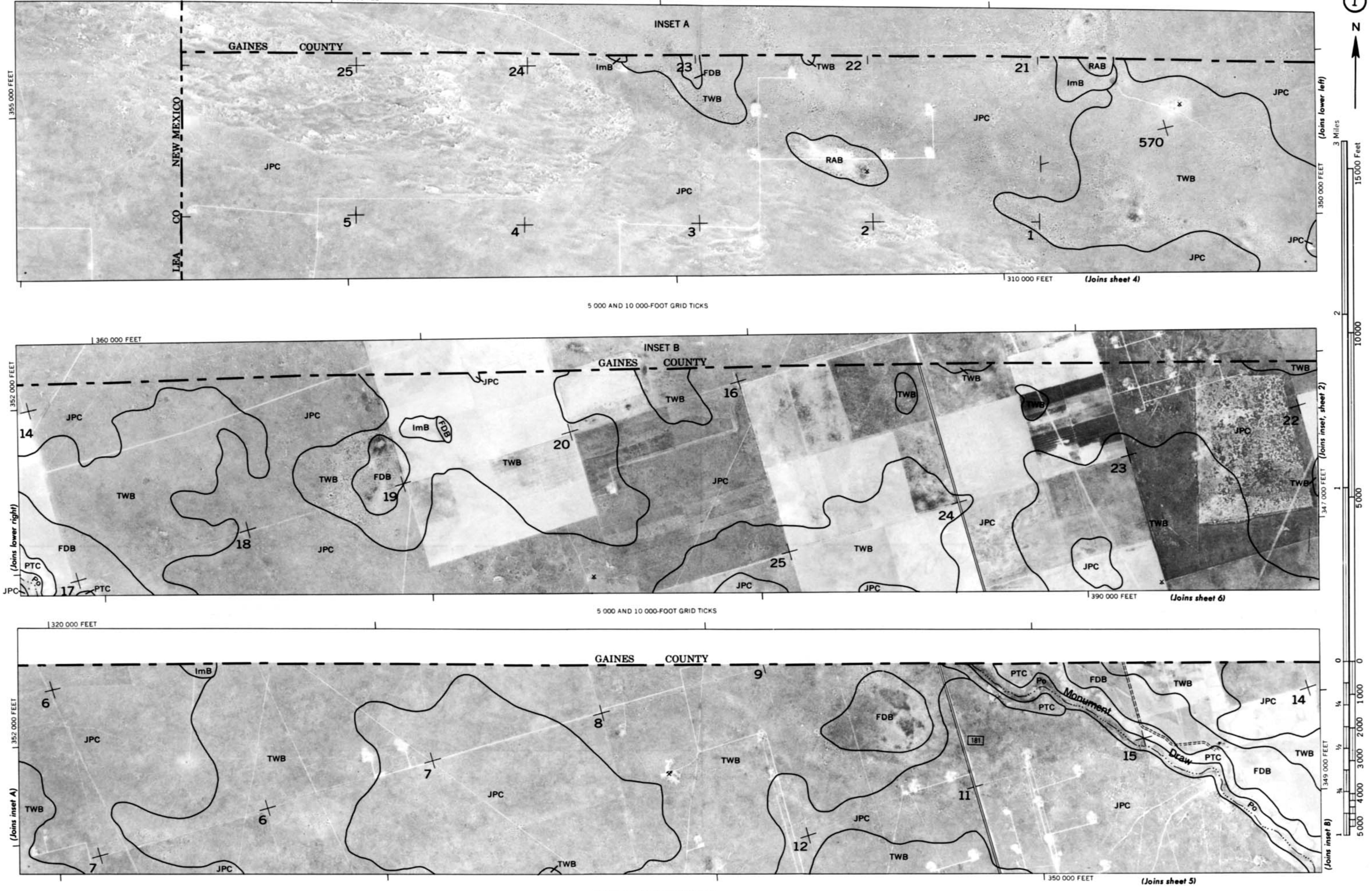
Made land

Severely eroded spot

Blowout, wind erosion

Gully

ANDREWS COUNTY, TEXAS — SHEET NUMBER 1

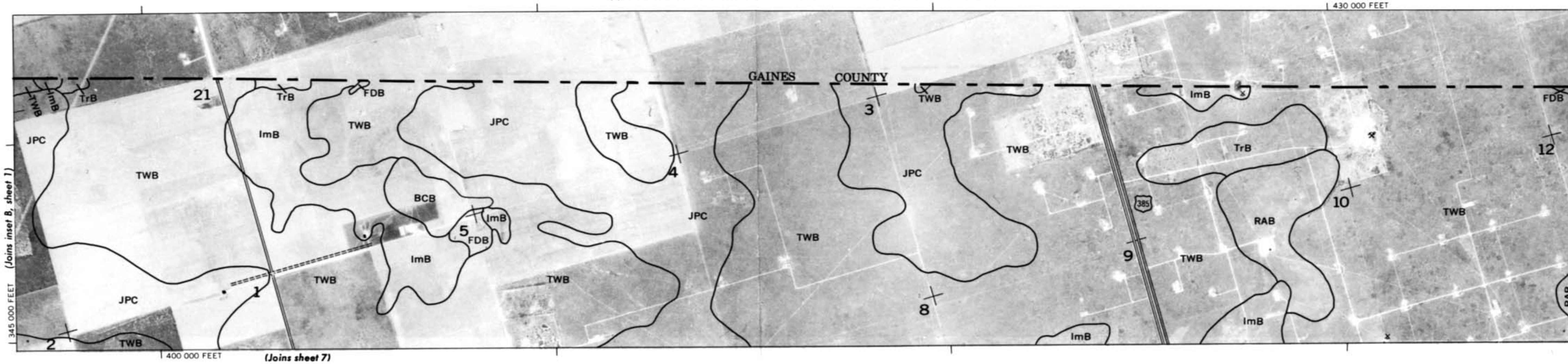


ANDREWS COUNTY, TEXAS NO. 1

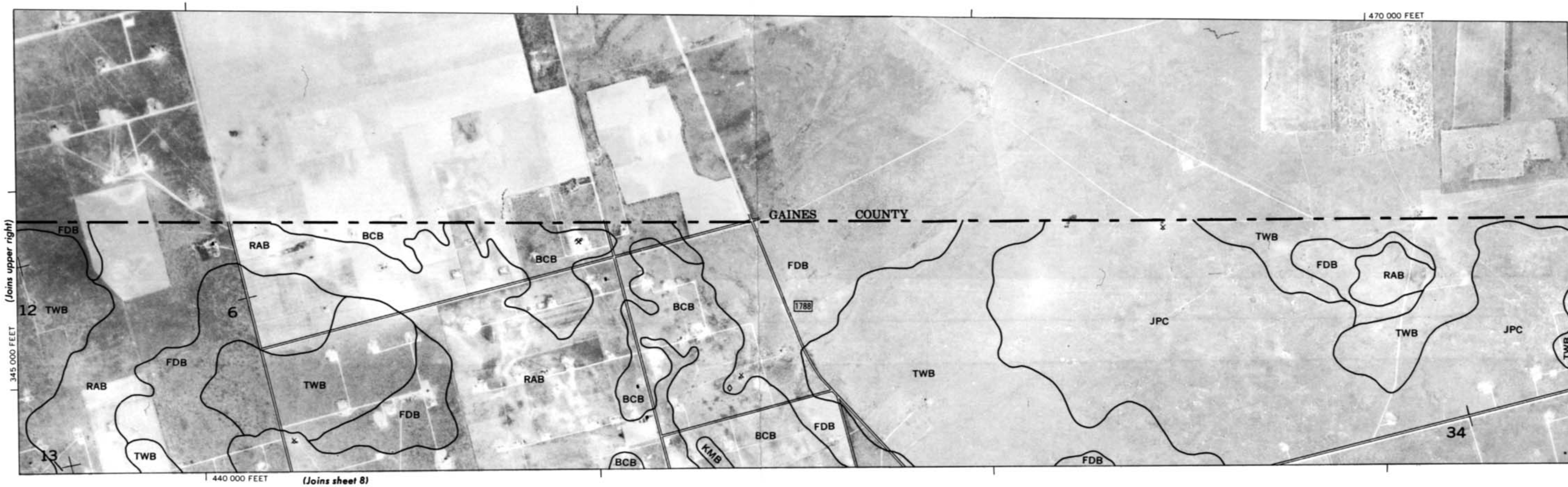
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

(2)

ANDREWS COUNTY, TEXAS — SHEET NUMBER 2



5 000 AND 10 000-FOOT GRID TICKS



5 000 AND 10 000-FOOT GRID TICKS

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

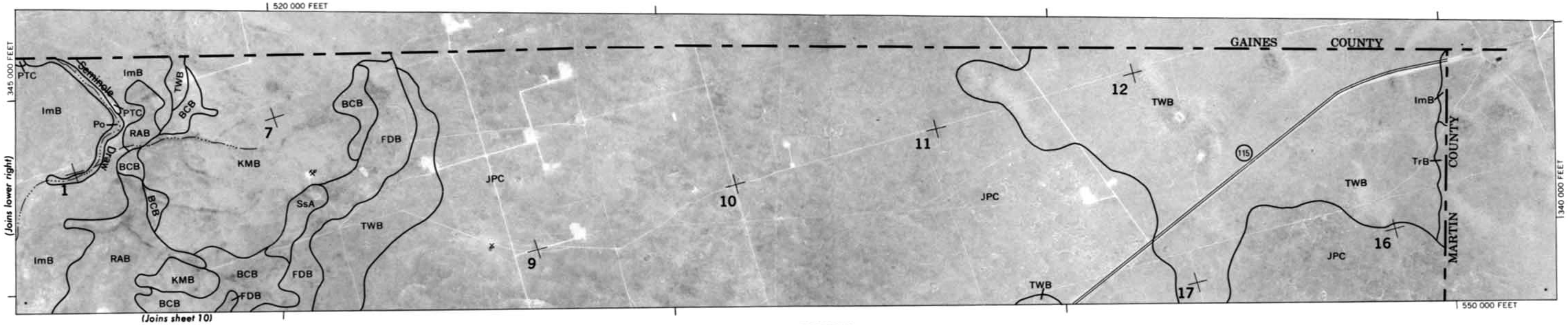
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

3

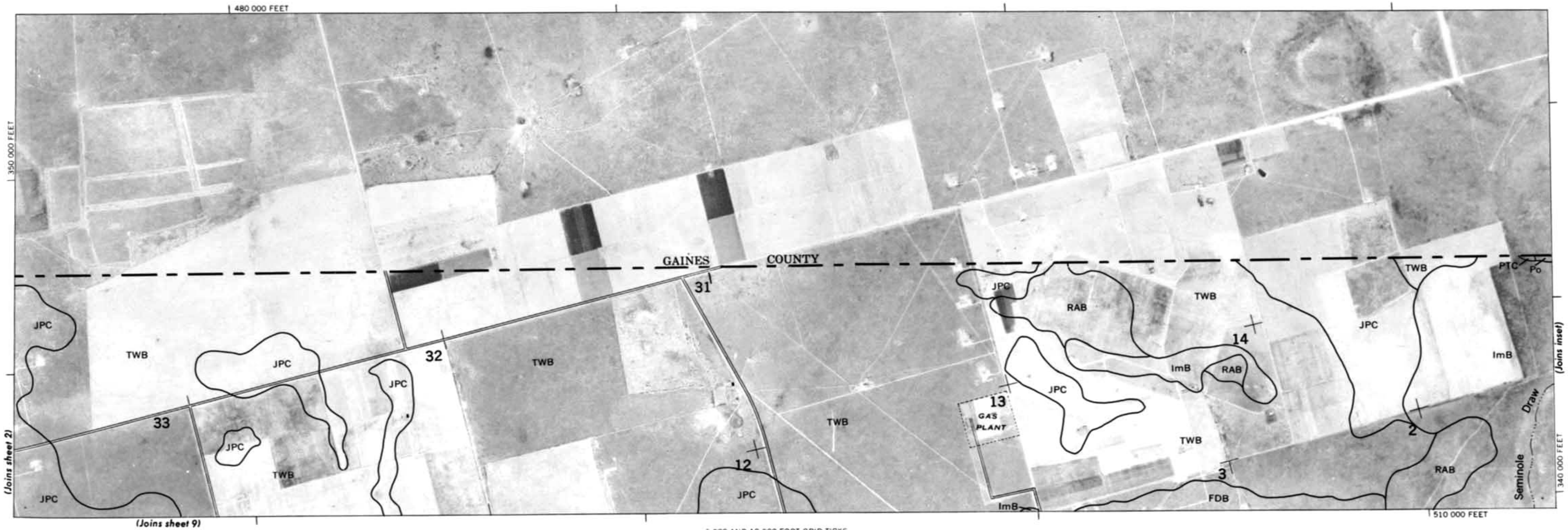
N

ANDREWS COUNTY, TEXAS NO. 3

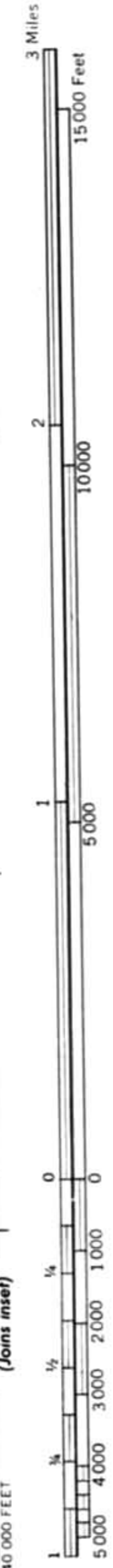
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone. Land division corners are approximately positioned on this map.



5 000 AND 10 000-FOOT GRID TICKS



5 000 AND 10 000-FOOT GRID TICKS



4

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

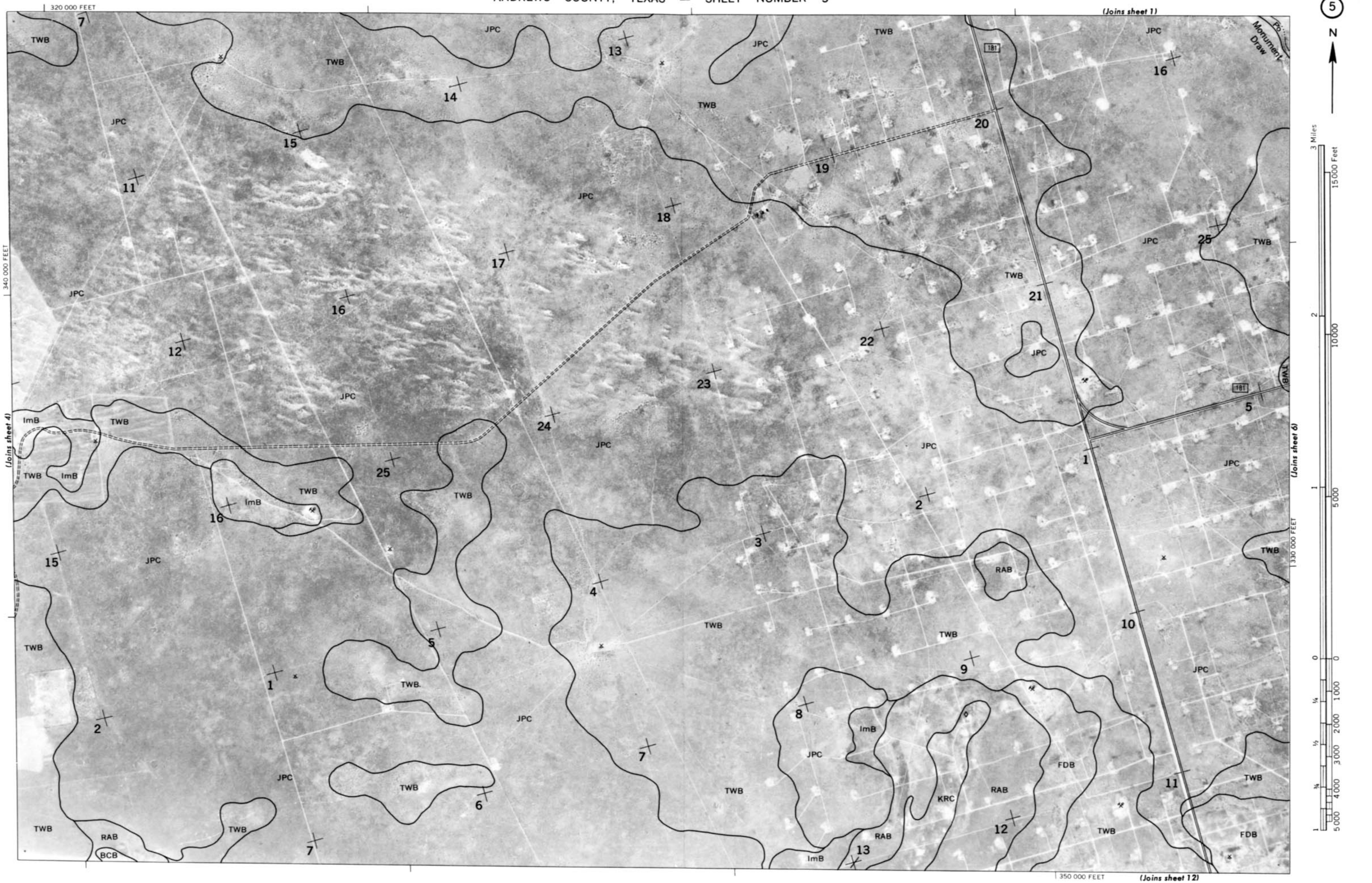
ANDREWS COUNTY, TEXAS NO. 4

ANDREWS COUNTY, TEXAS NO. 5

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

Land division corners are approximately positioned on this map.



ANDREWS COUNTY, TEXAS — SHEET NUMBER 6

Land division corners are approximately positioned on this map.

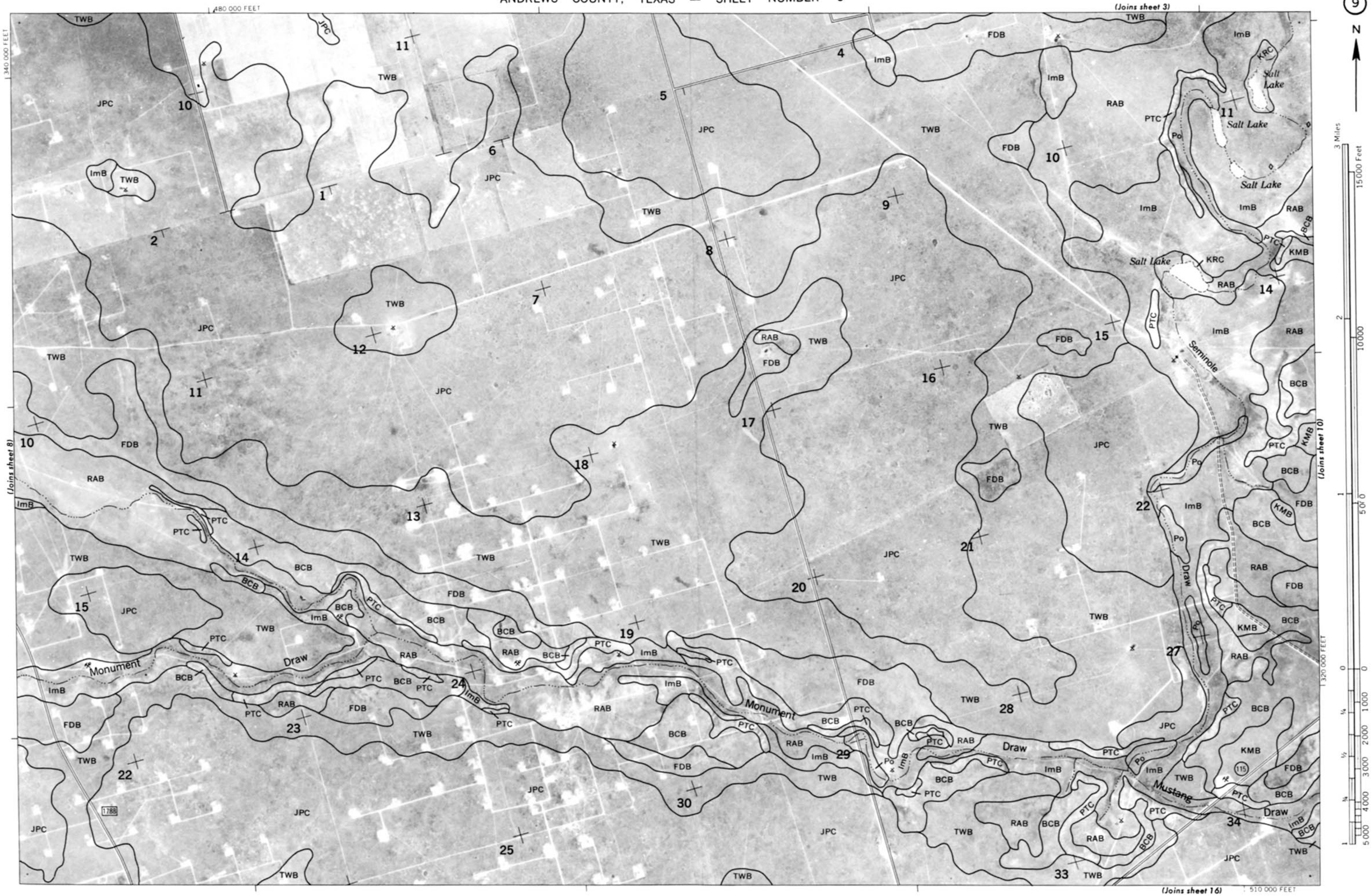
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 8

Land division corners are approximately positioned on this map.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



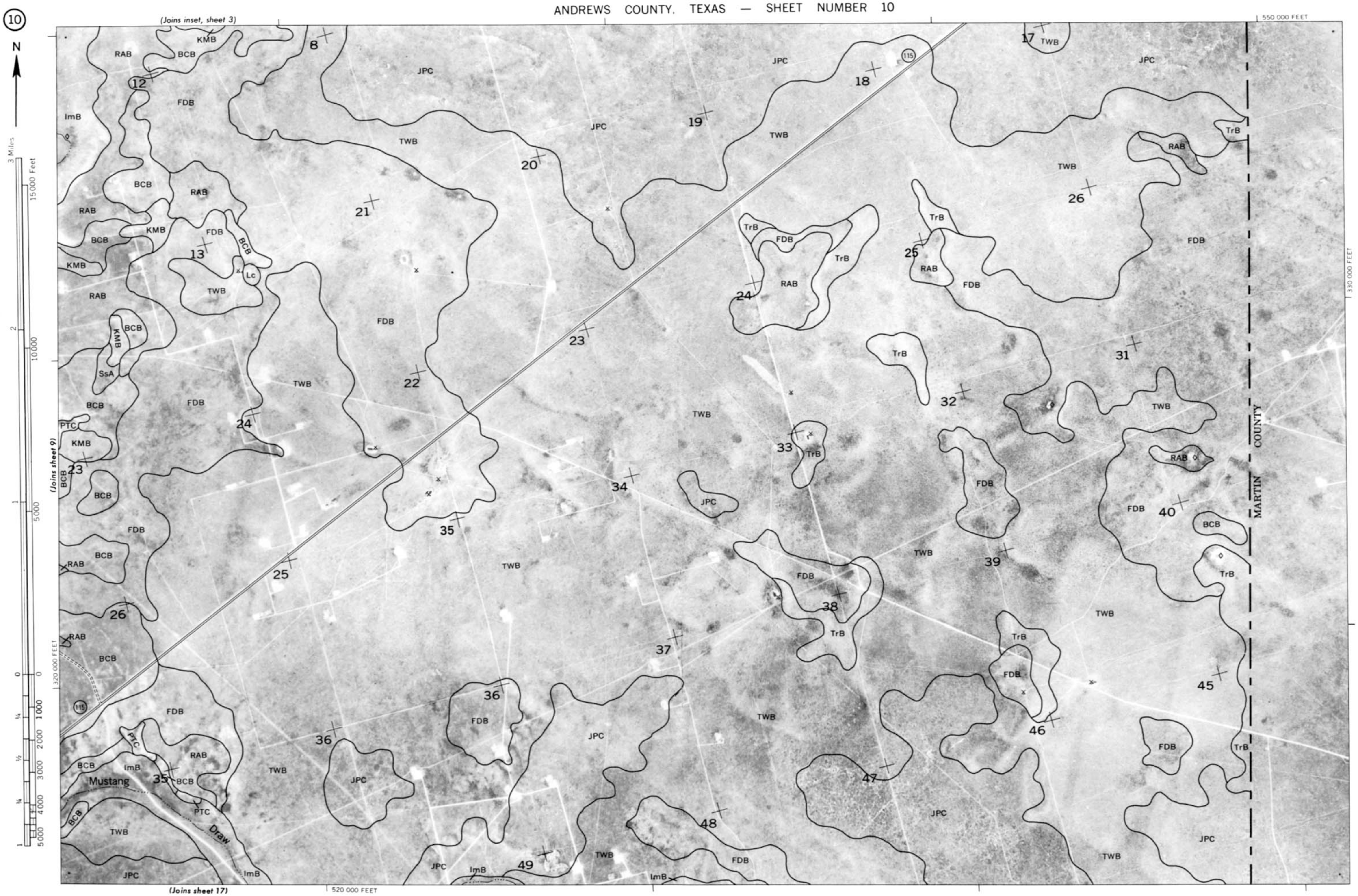
ANDREWS COUNTY, TEXAS NO. 9

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

Land division corners are approximately positioned on this map.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 10

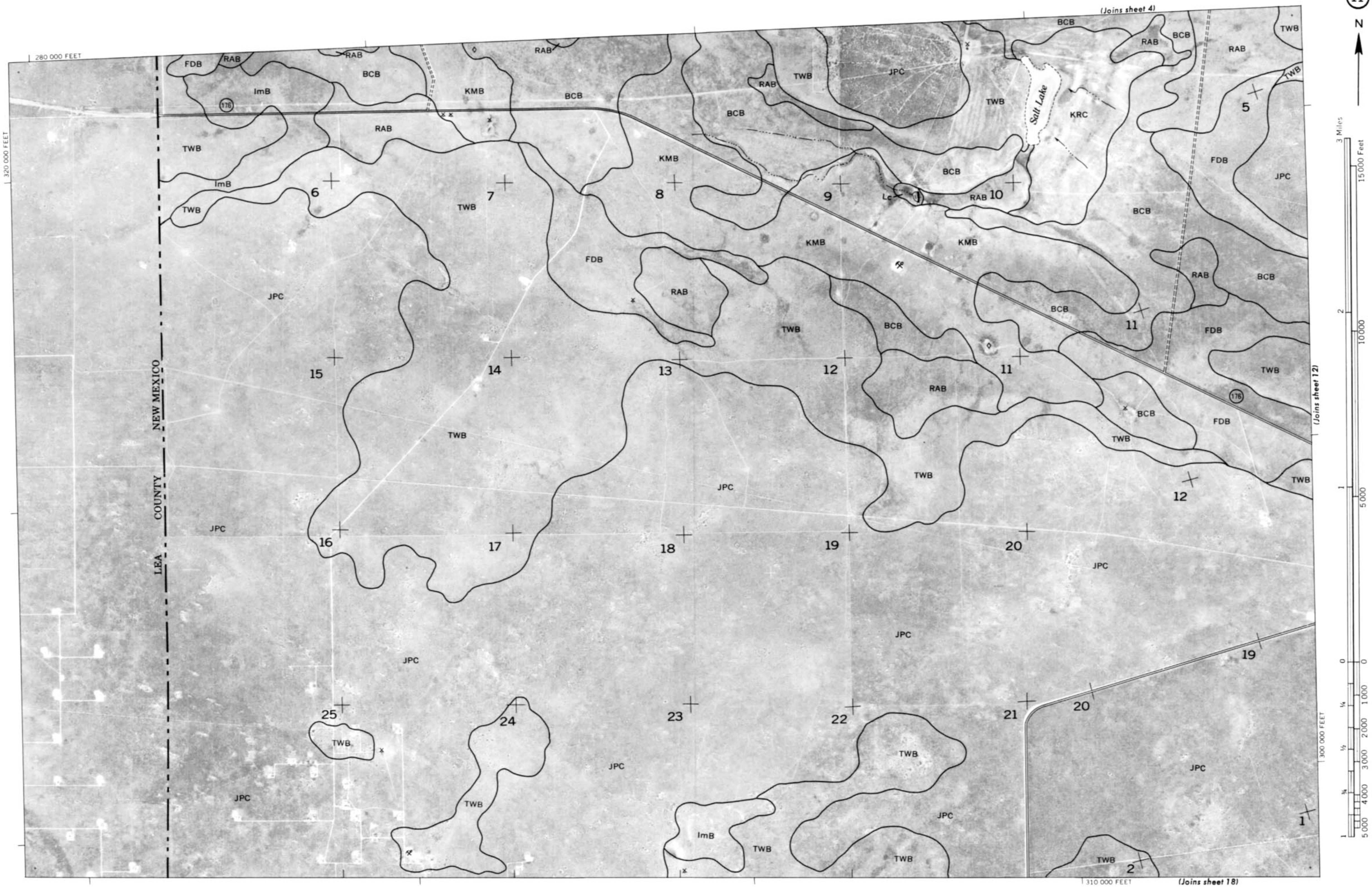


Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

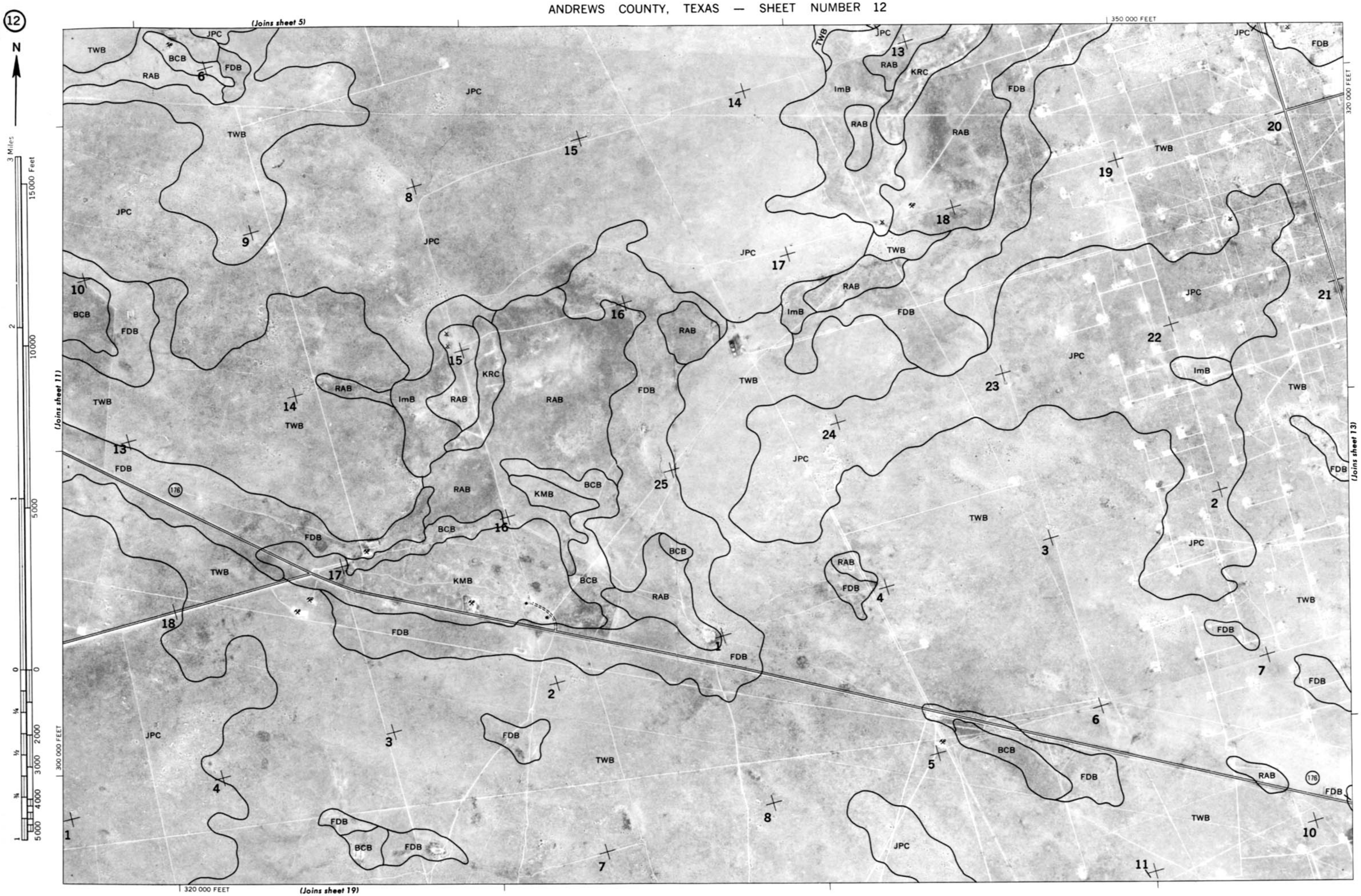
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 10



ANDREWS COUNTY, TEXAS NO. 11

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone. Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 13

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

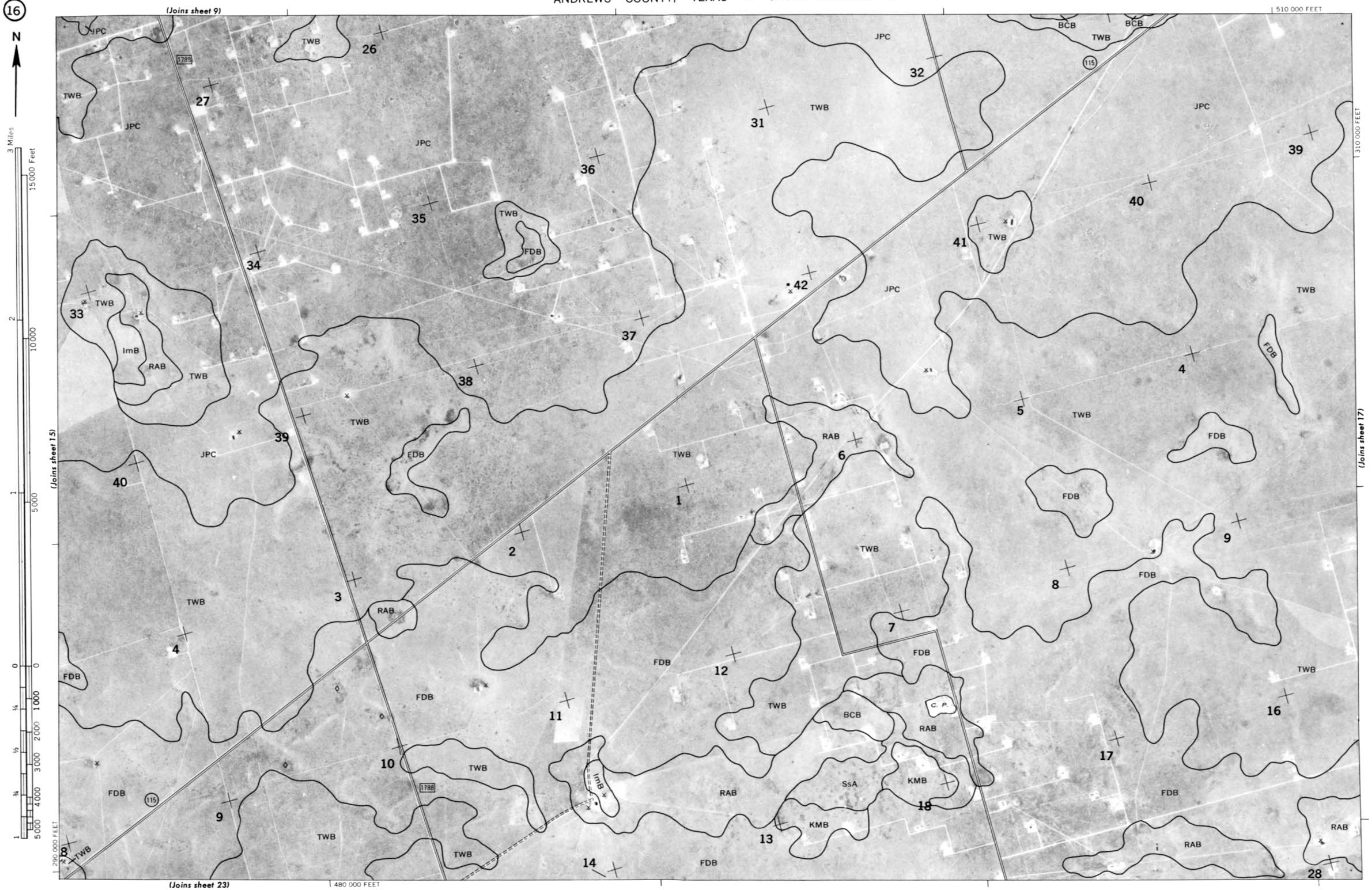
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 14

15

ANDREWS COUNTY, TEXAS NO. 15

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

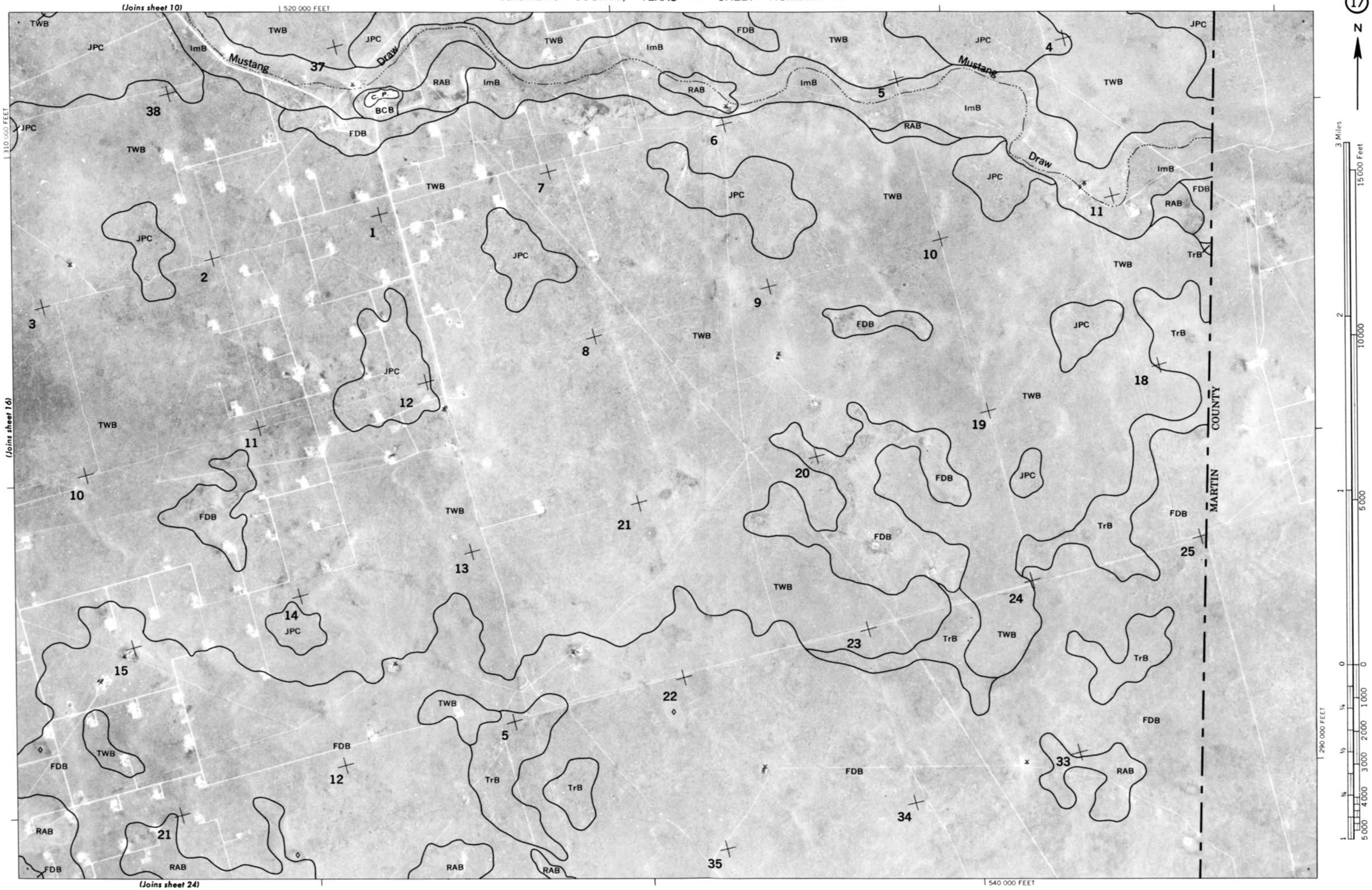


Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

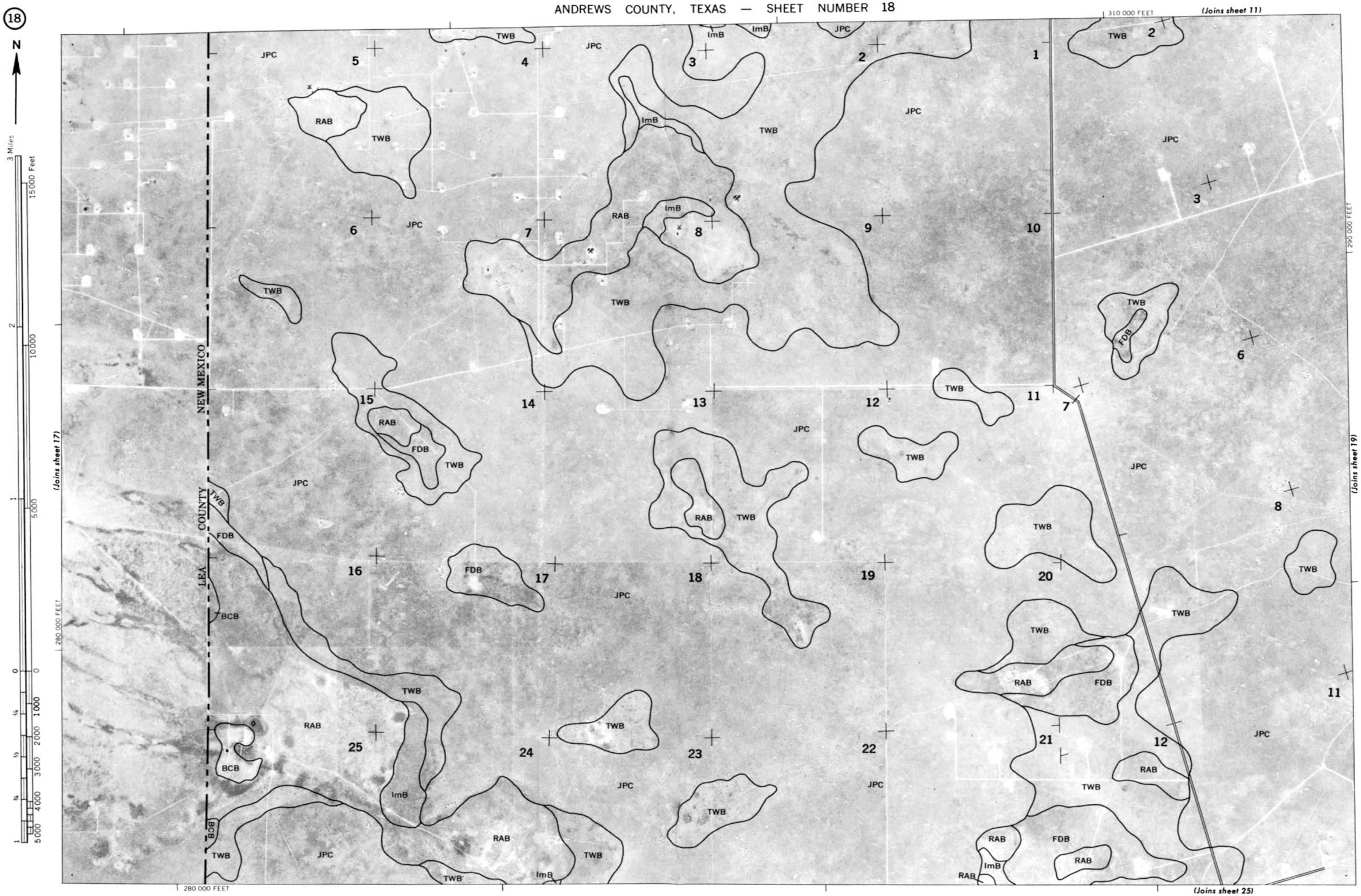
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 17



ANDREWS COUNTY, TEXAS NO. 17

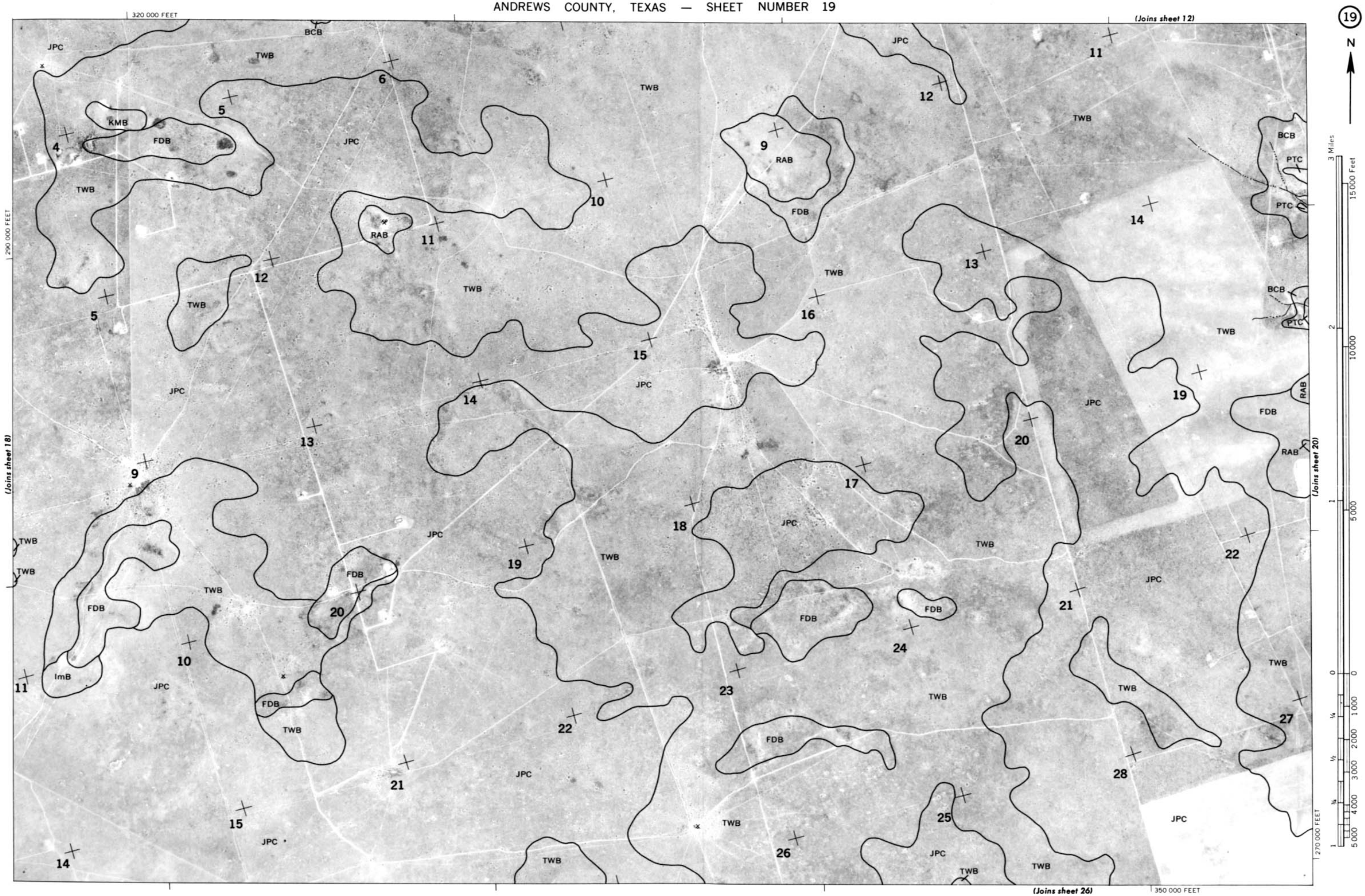
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone. Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

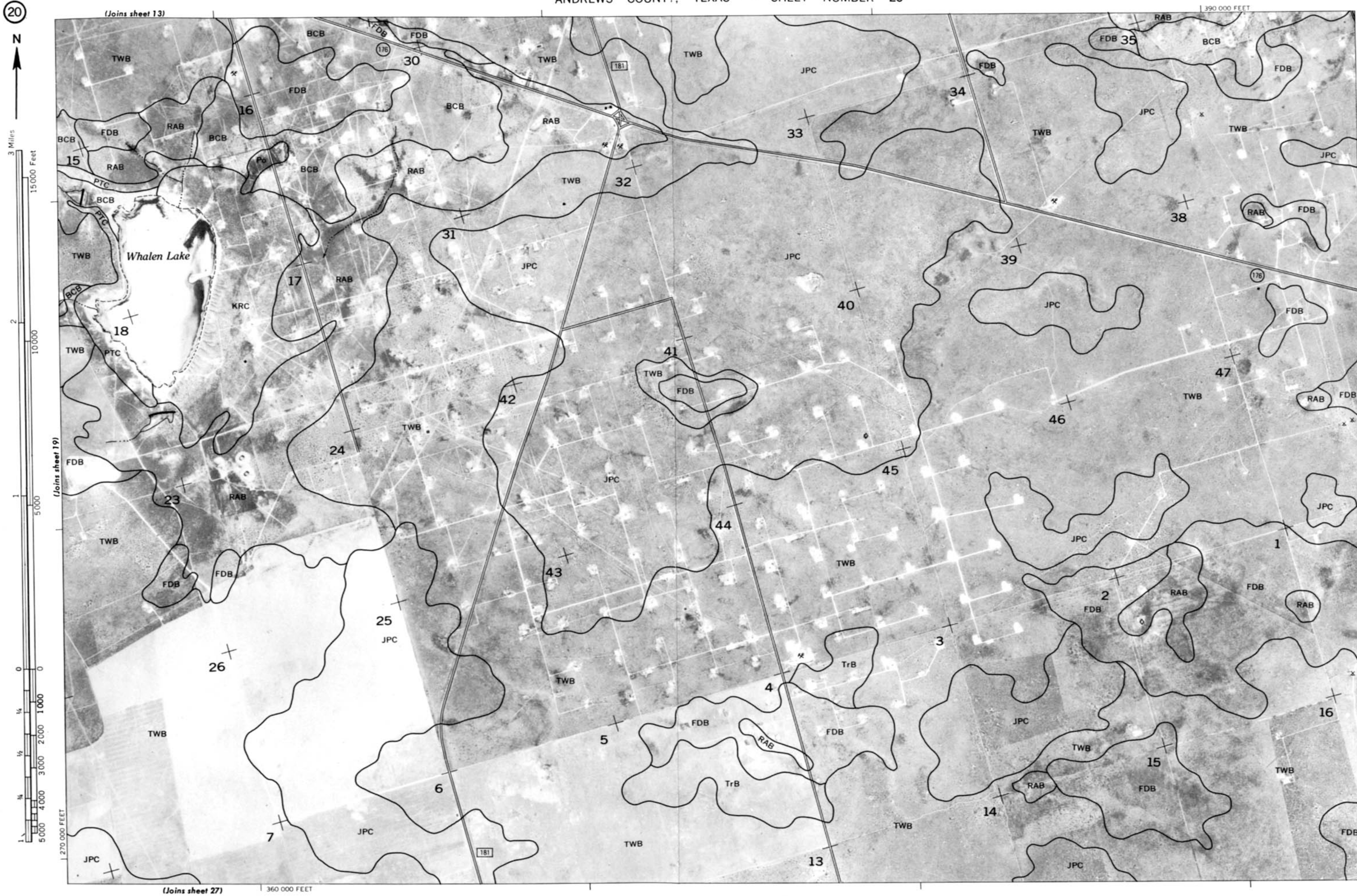
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.



ANDREWS COUNTY, TEXAS NO. 19

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

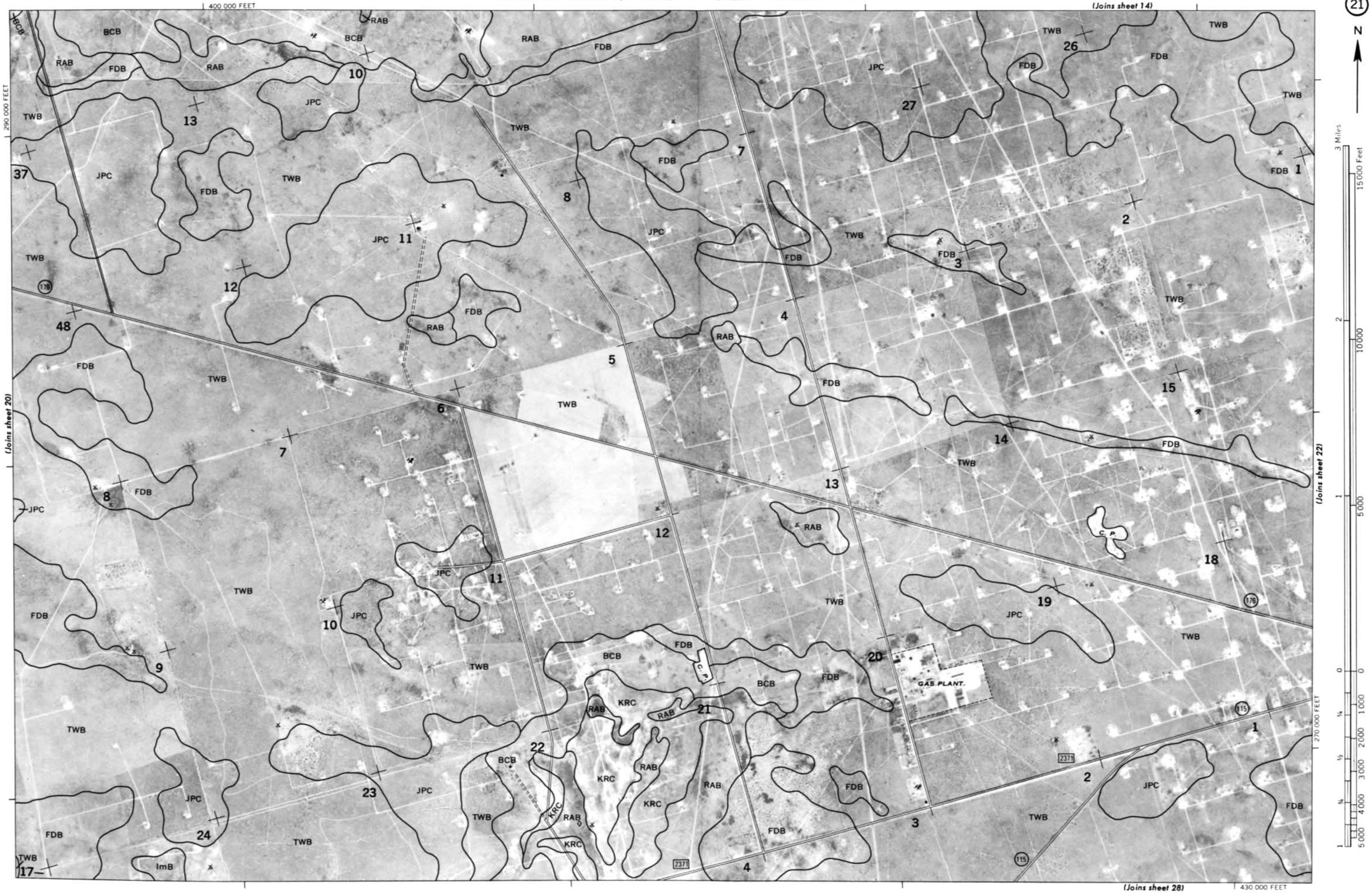


Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 21



ANDREWS COUNTY, TEXAS NO. 21

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

Land division corners are approximately positioned on this map.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 22

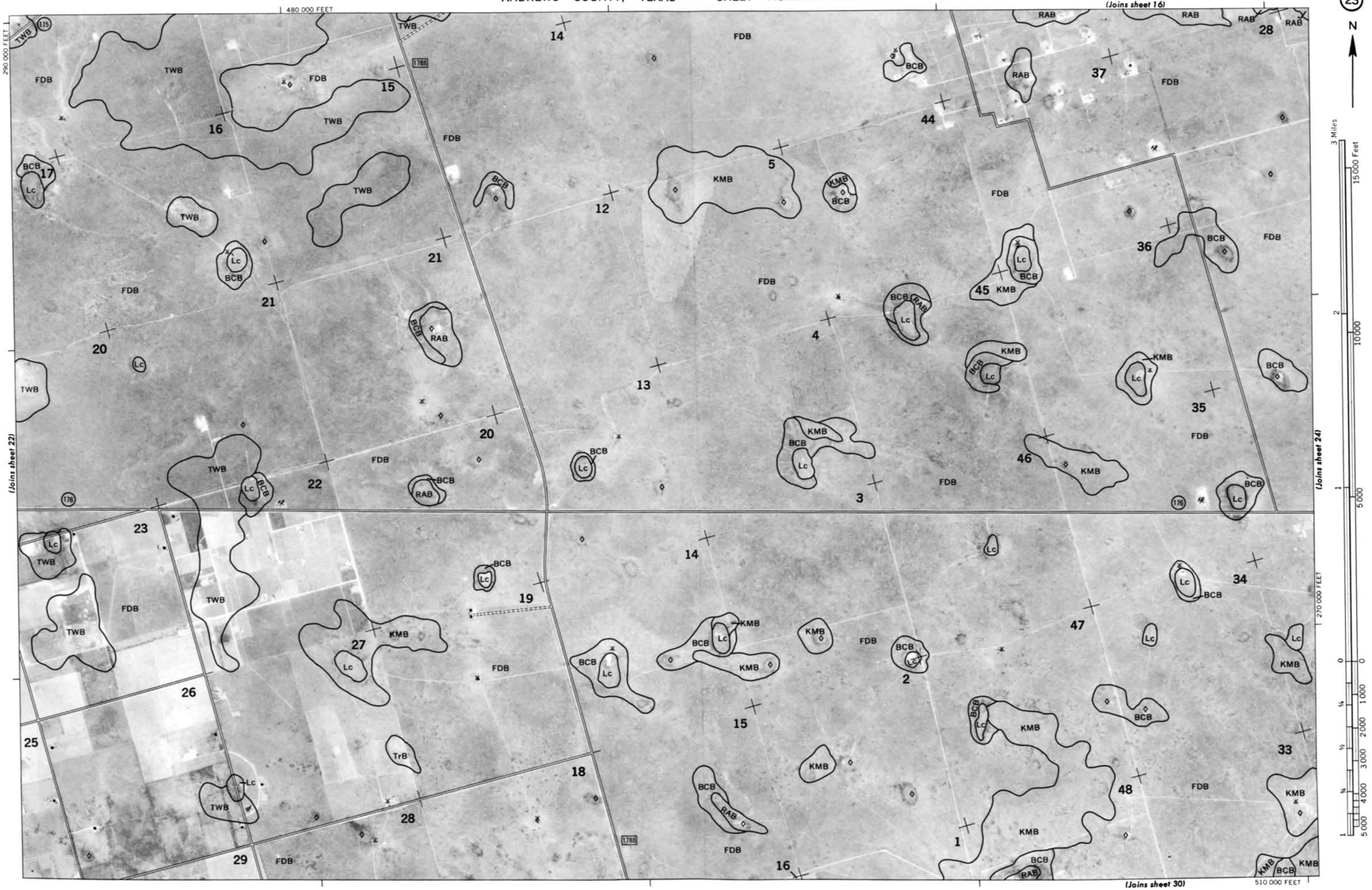
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 22

ANDREWS COUNTY, TEXAS — SHEET NUMBER 23

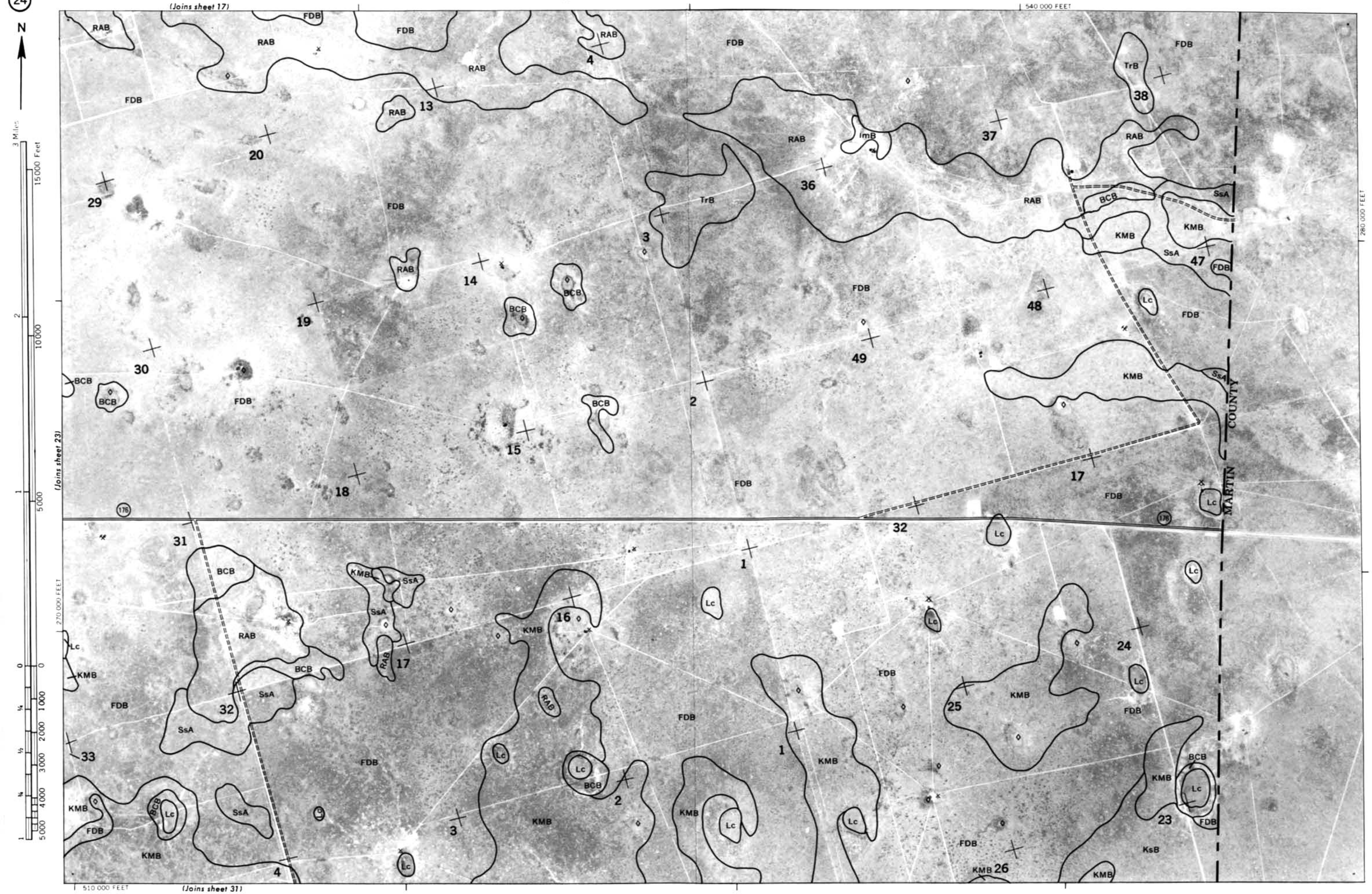


ANDREWS COUNTY, TEXAS NO. 23

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

24

ANDREWS COUNTY, TEXAS — SHEET NUMBER 24



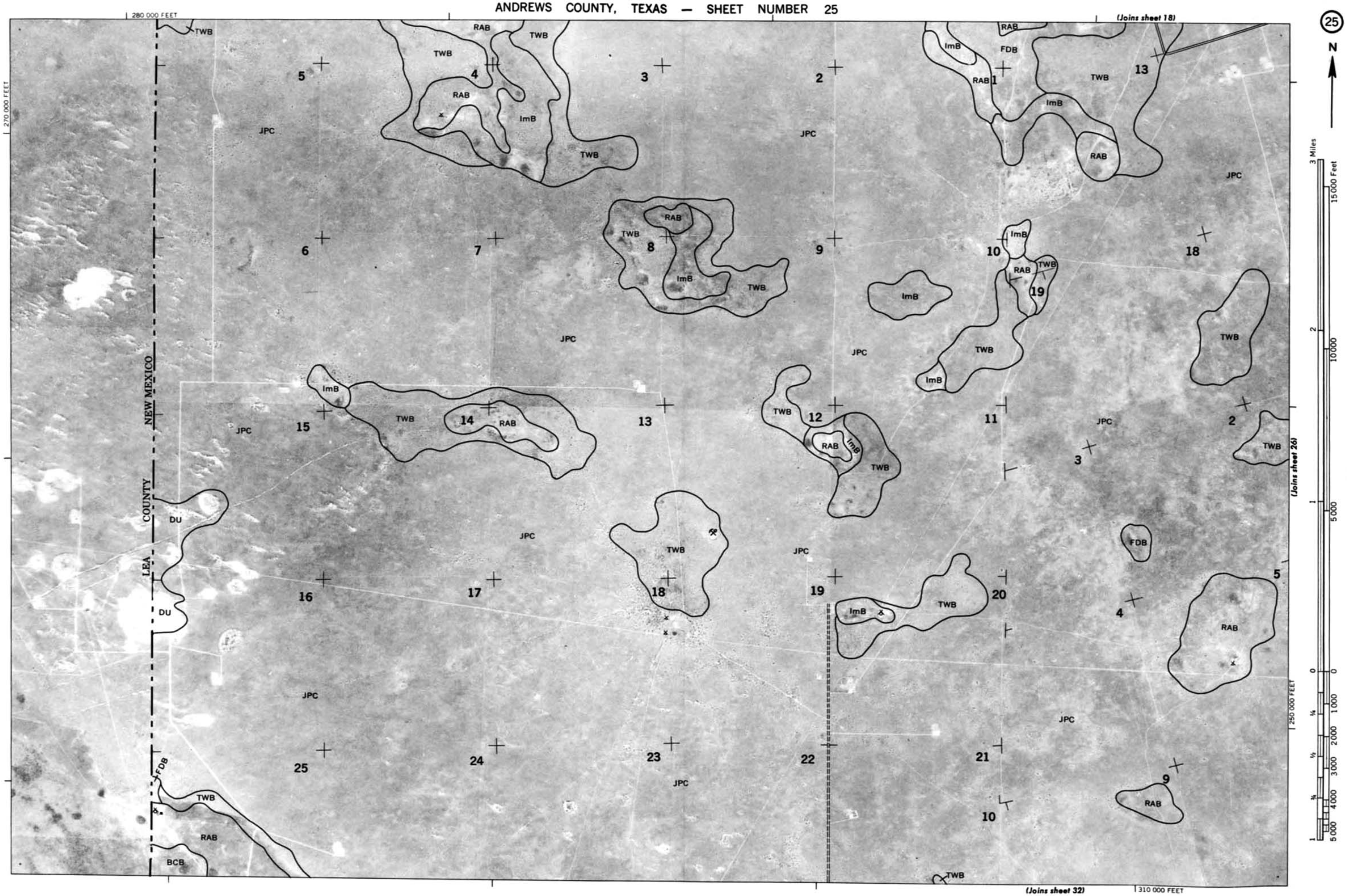
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 24

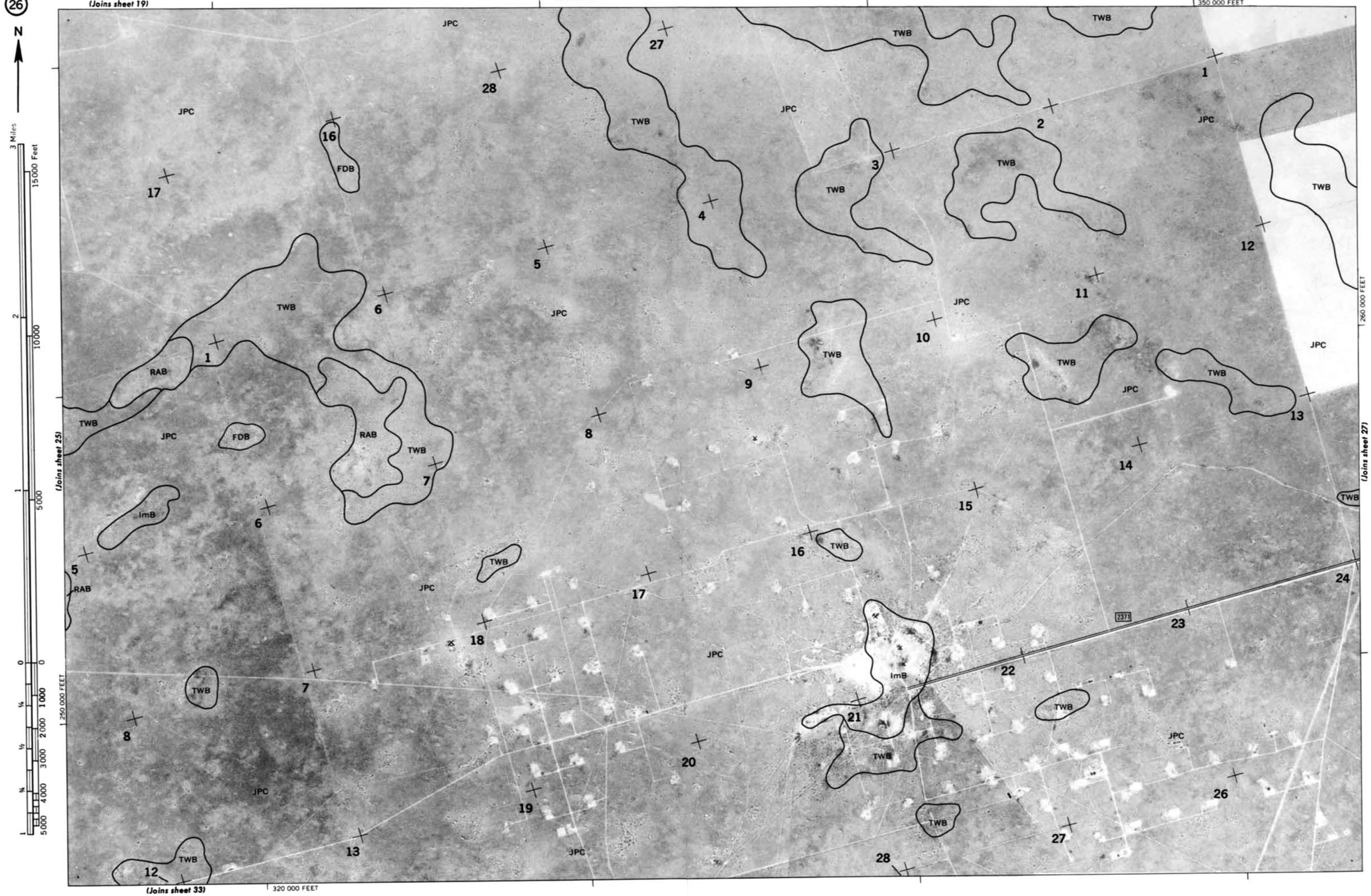
ANDREWS COUNTY, TEXAS — SHEET NUMBER 25



ANDREWS COUNTY, TEXAS NO. 25

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 26



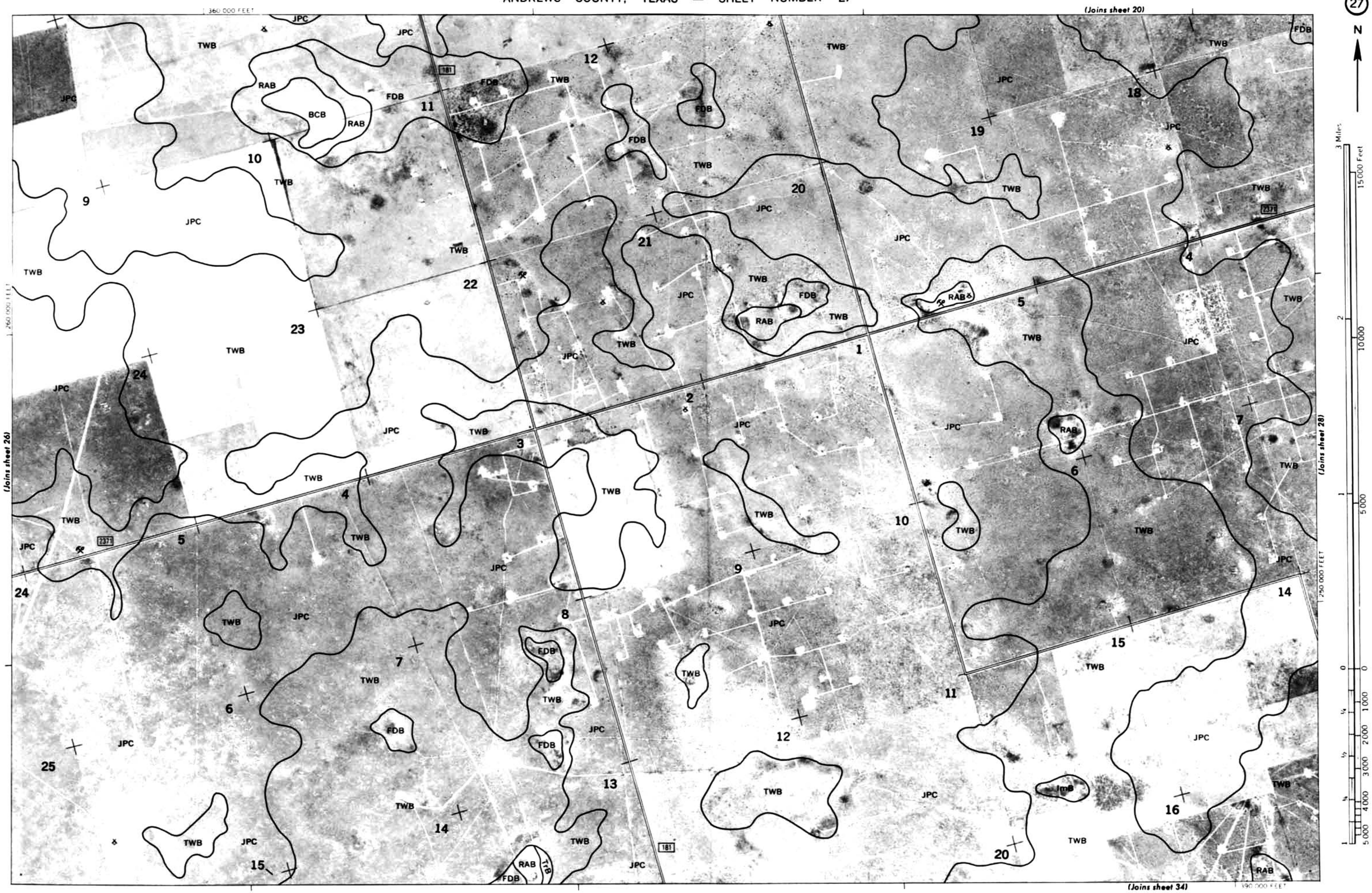
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 26

(27)



ANDREWS COUNTY, TEXAS NO. 27

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

29

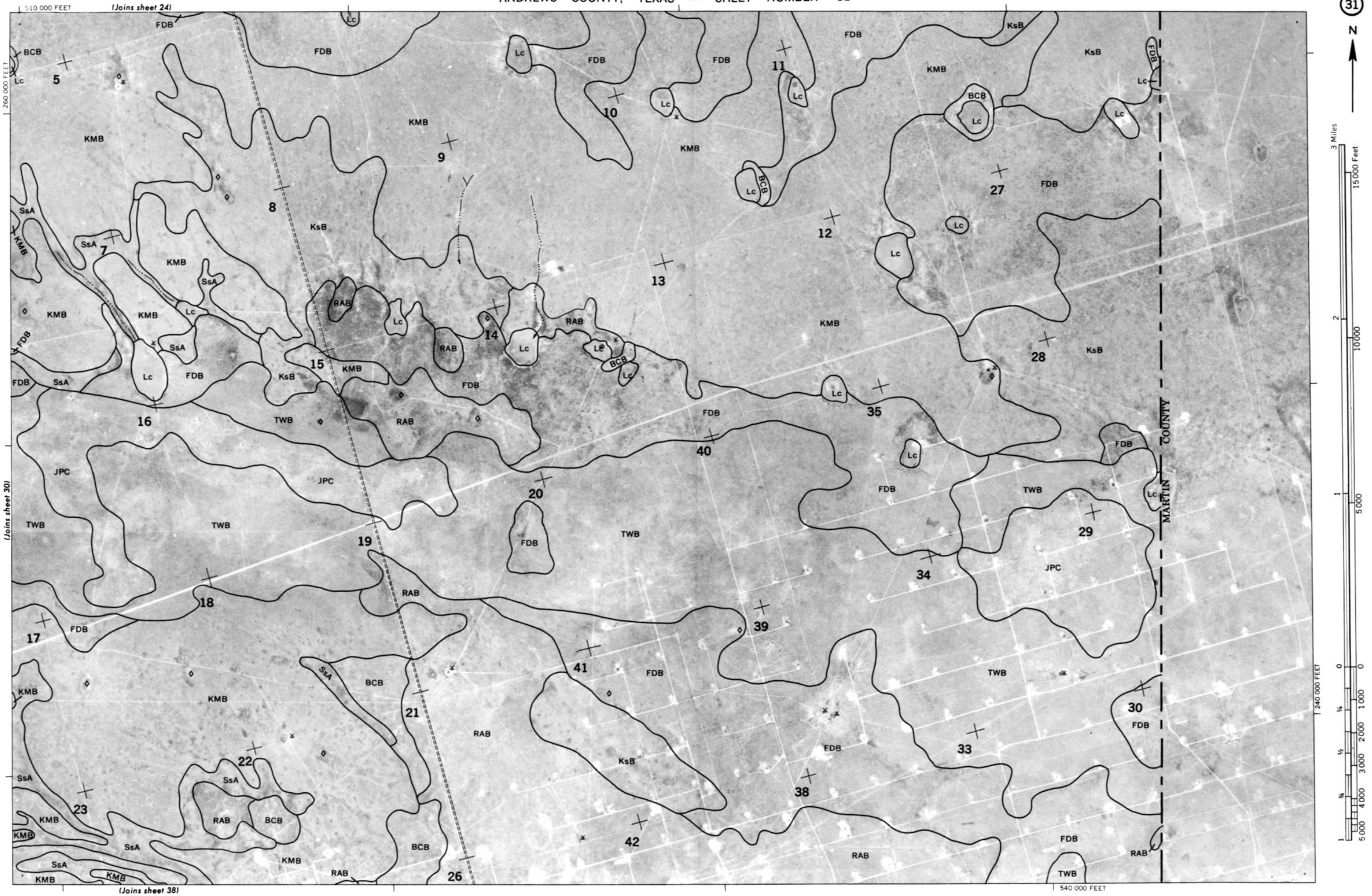
ANDREWS COUNTY, TEXAS NO. 29

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

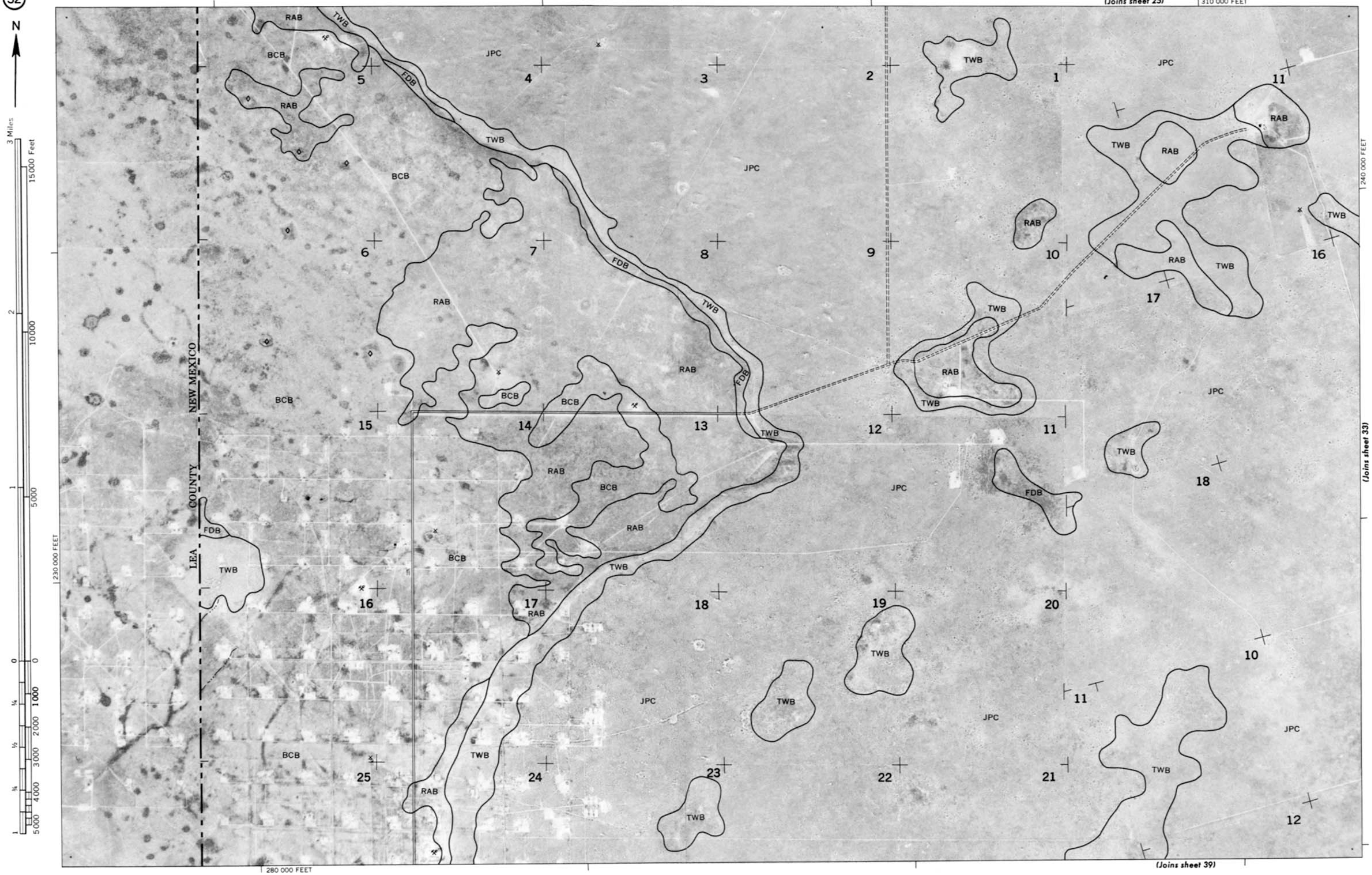


ANDREWS COUNTY, TEXAS NO. 31

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

(32)

ANDREWS COUNTY, TEXAS — SHEET NUMBER 32



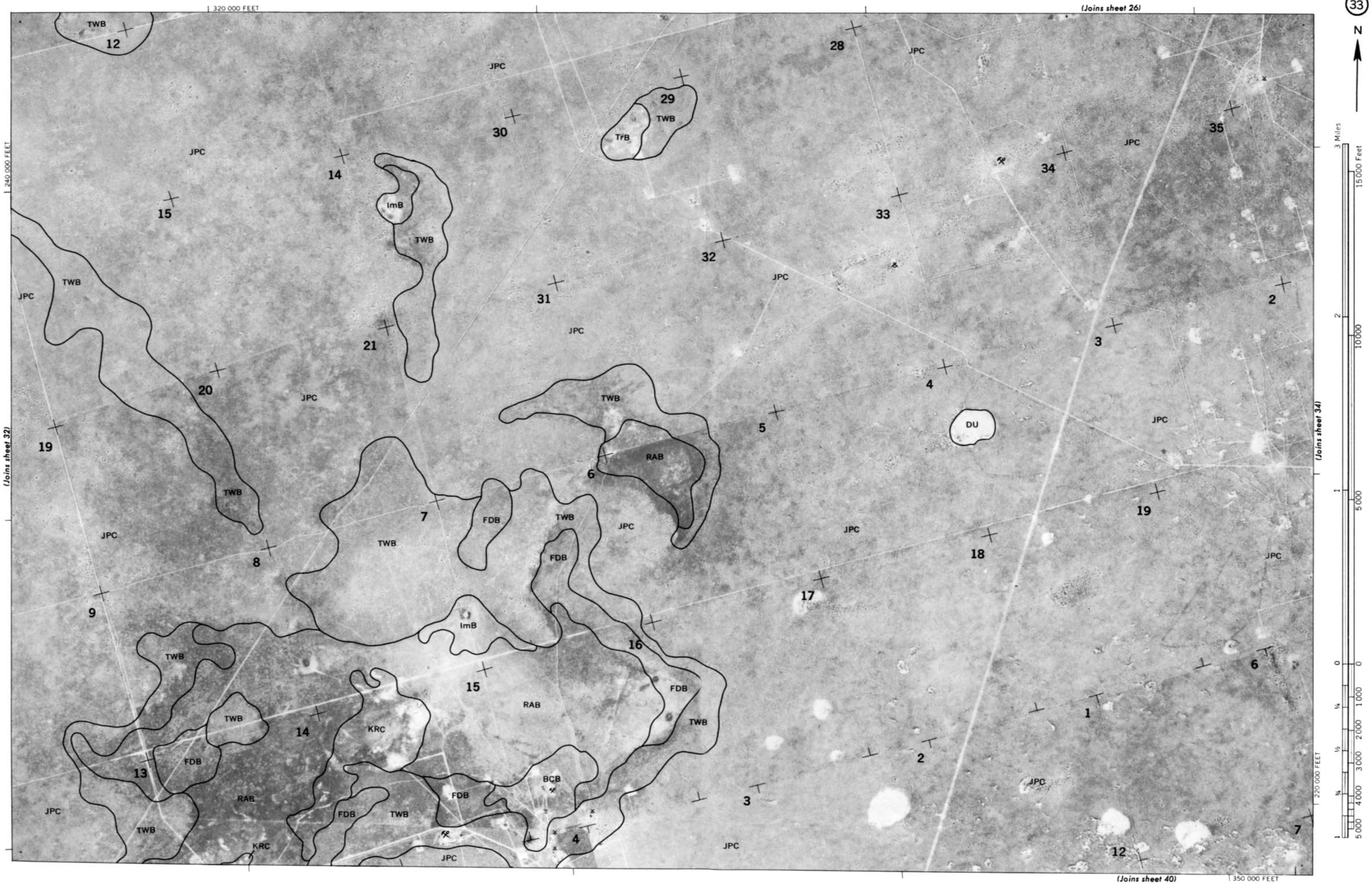
Land division corners are approximately positioned on this map.

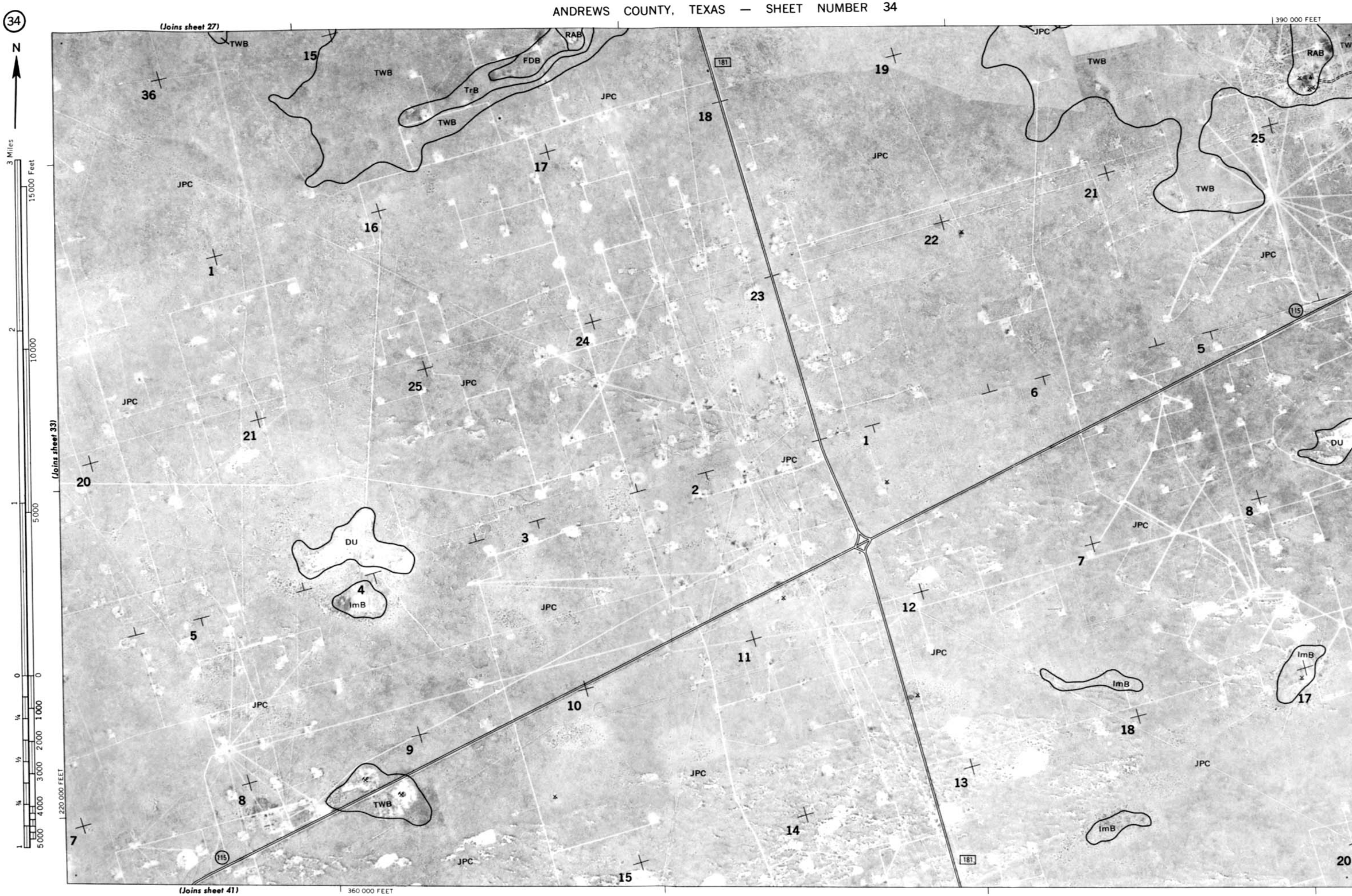
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 32

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.



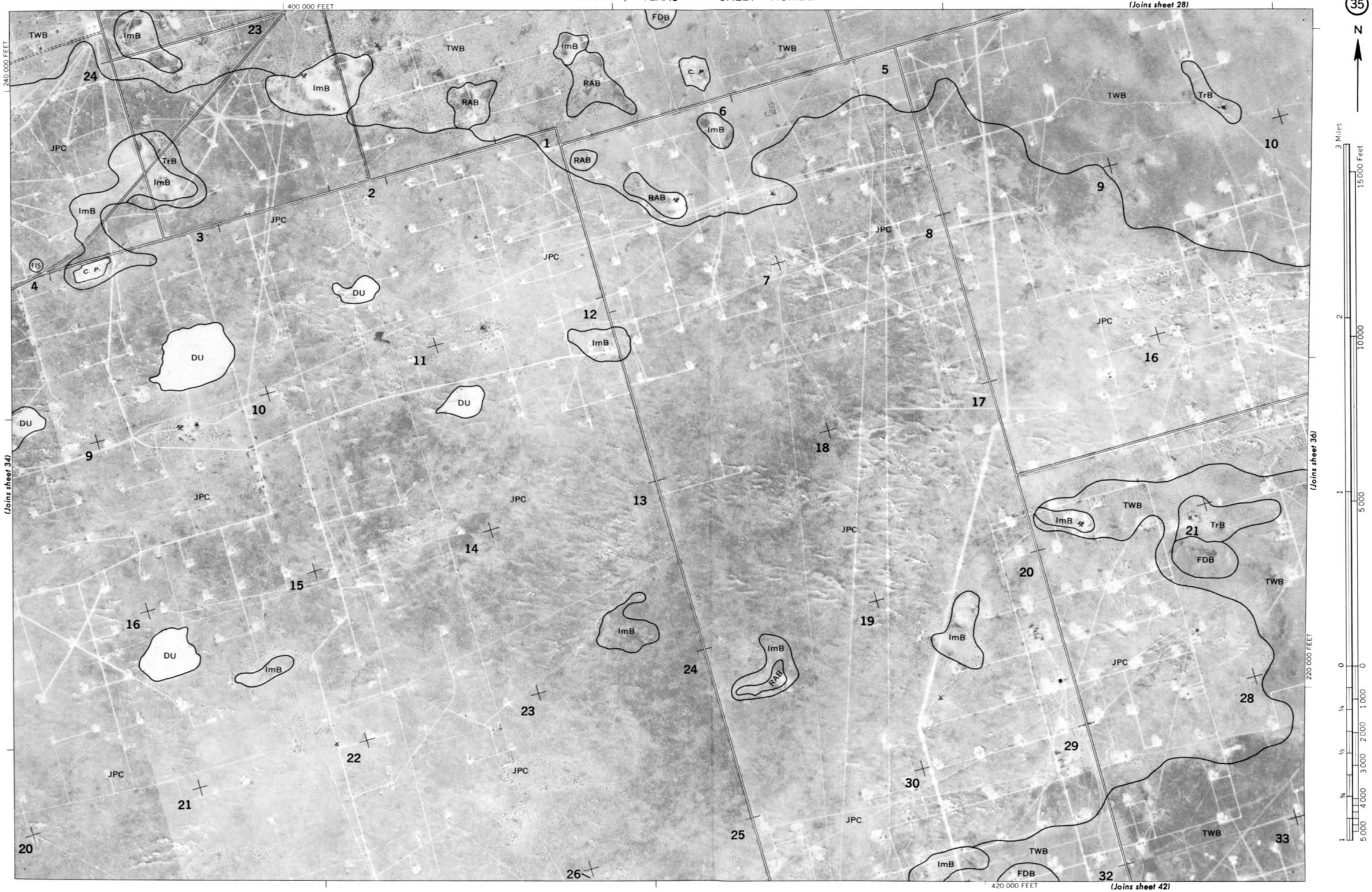


Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

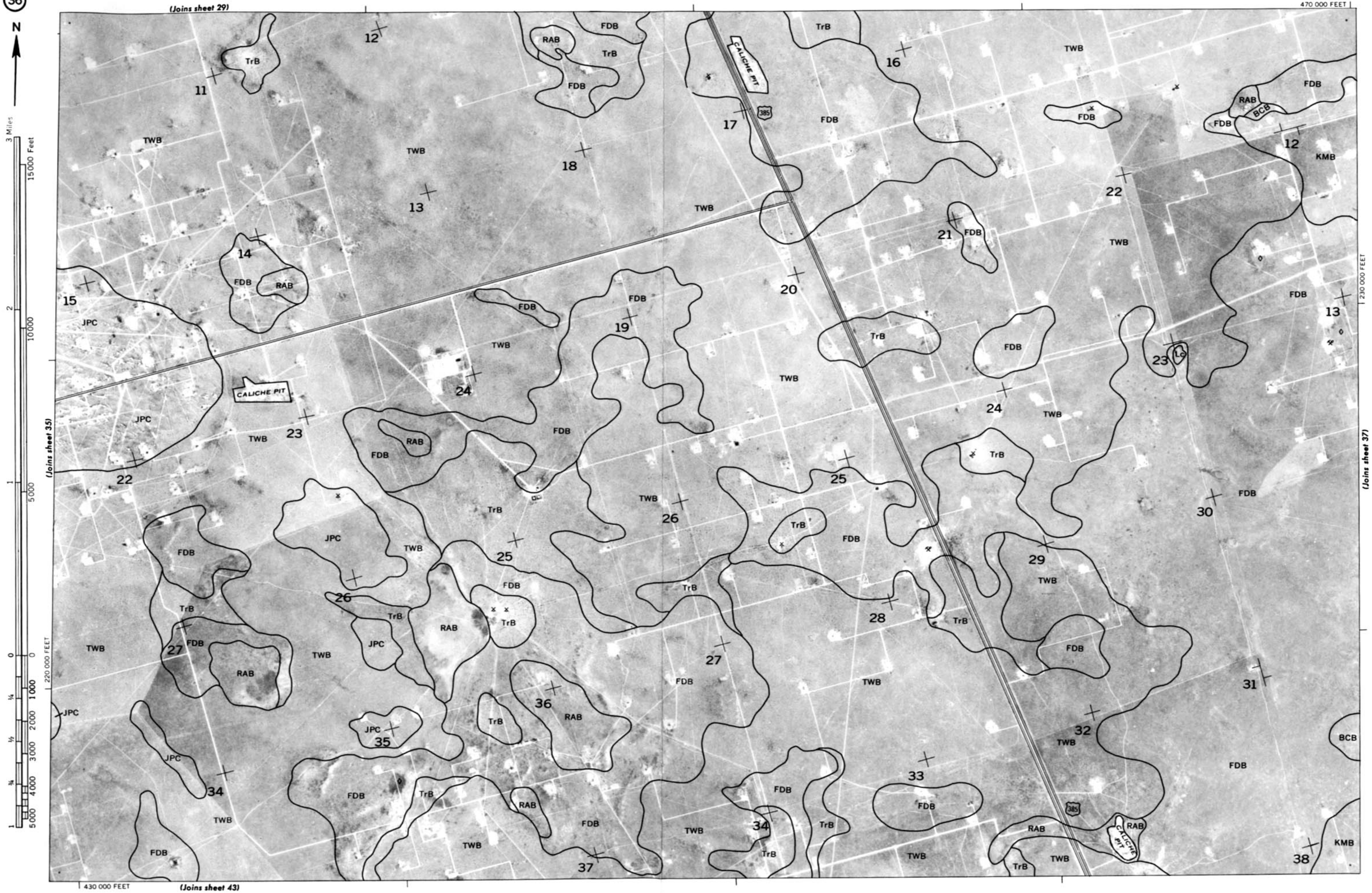
ANDREWS COUNTY, TEXAS — SHEET NUMBER 35



ANDREWS COUNTY, TEXAS NO. 35

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 36



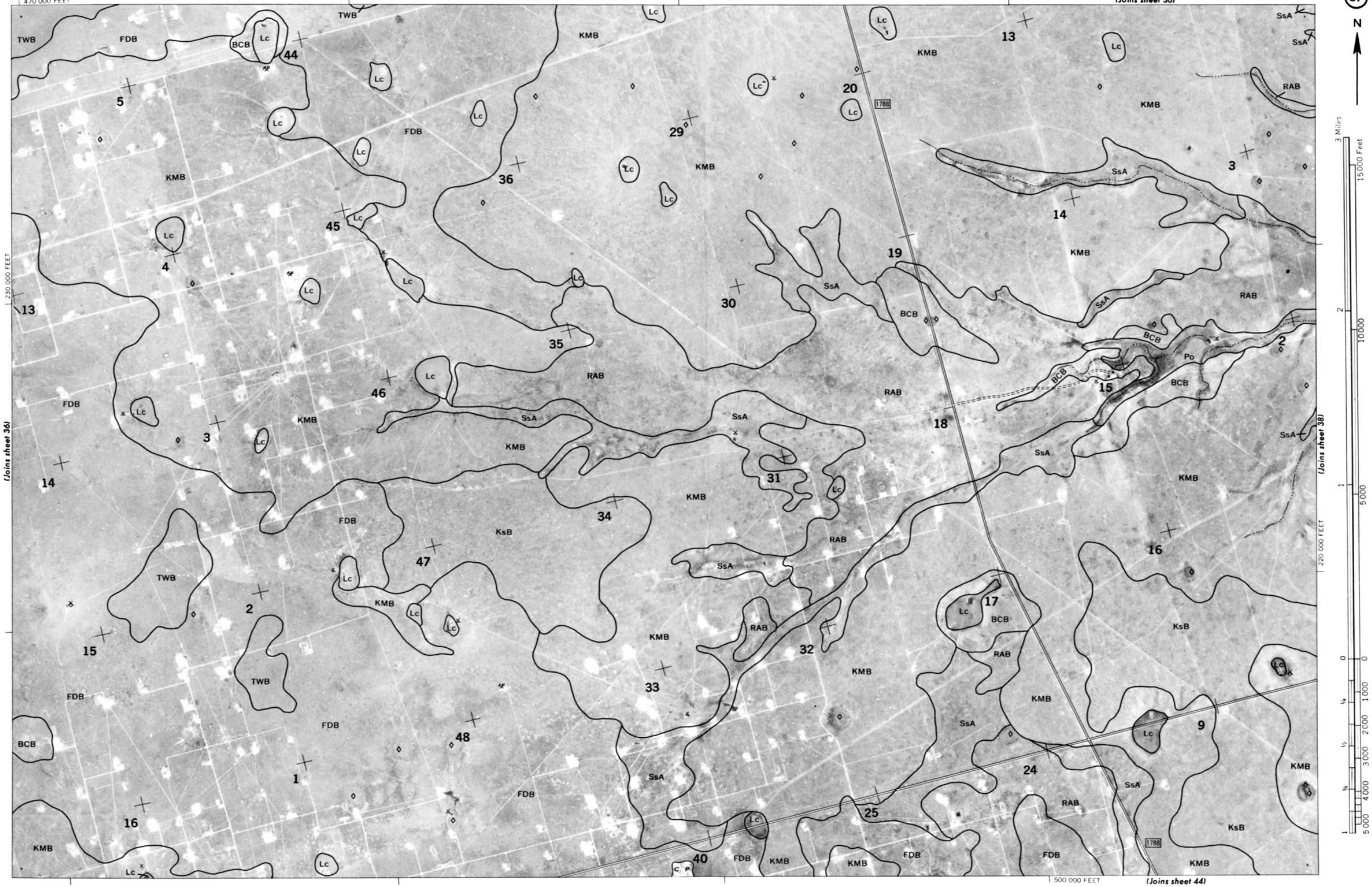
Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 36

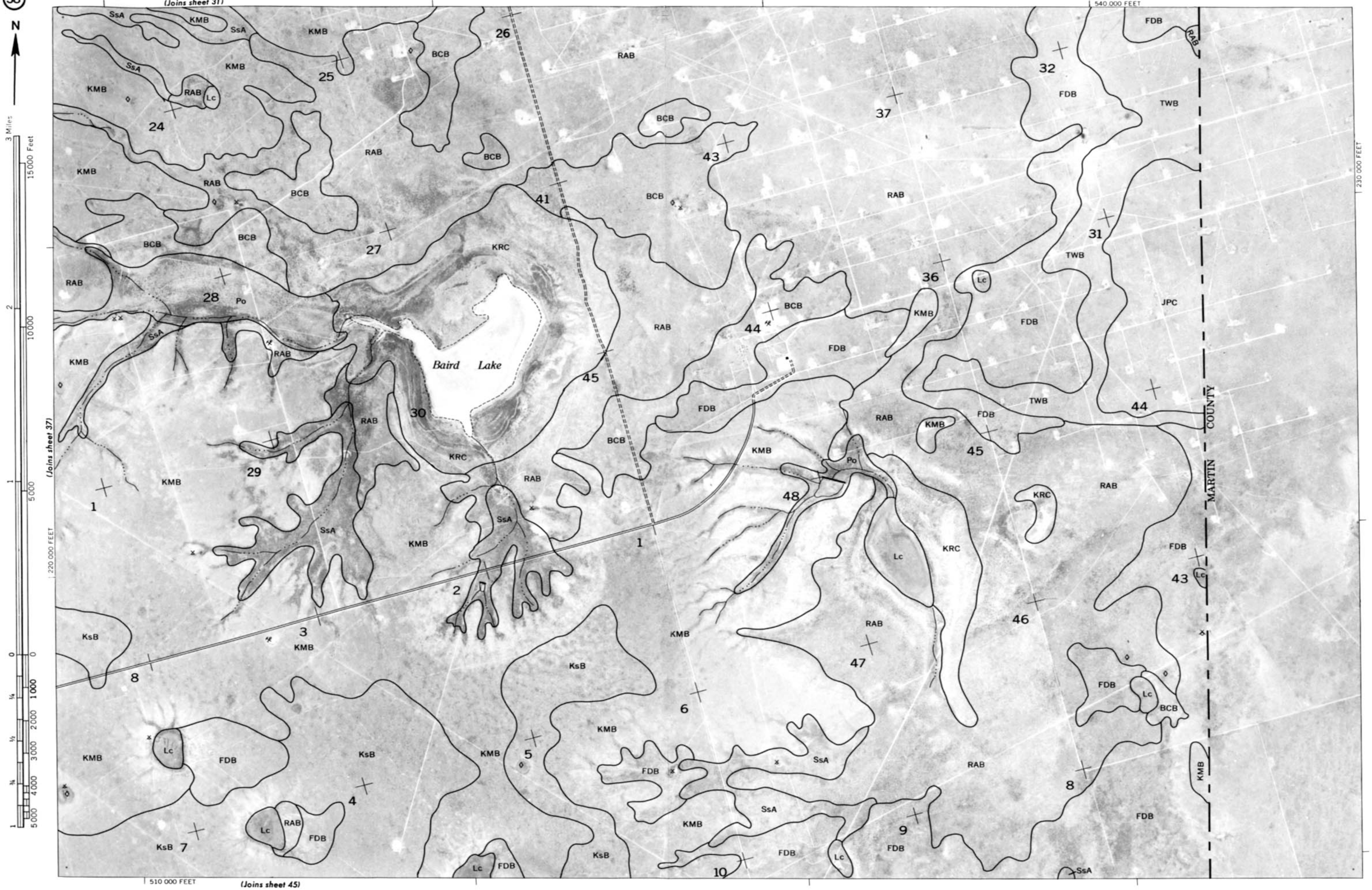
ANDREWS COUNTY, TEXAS — SHEET NUMBER 37



ANDREWS COUNTY, TEXAS NO. 37

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone. Land division corners are approximately positioned on this map.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 38



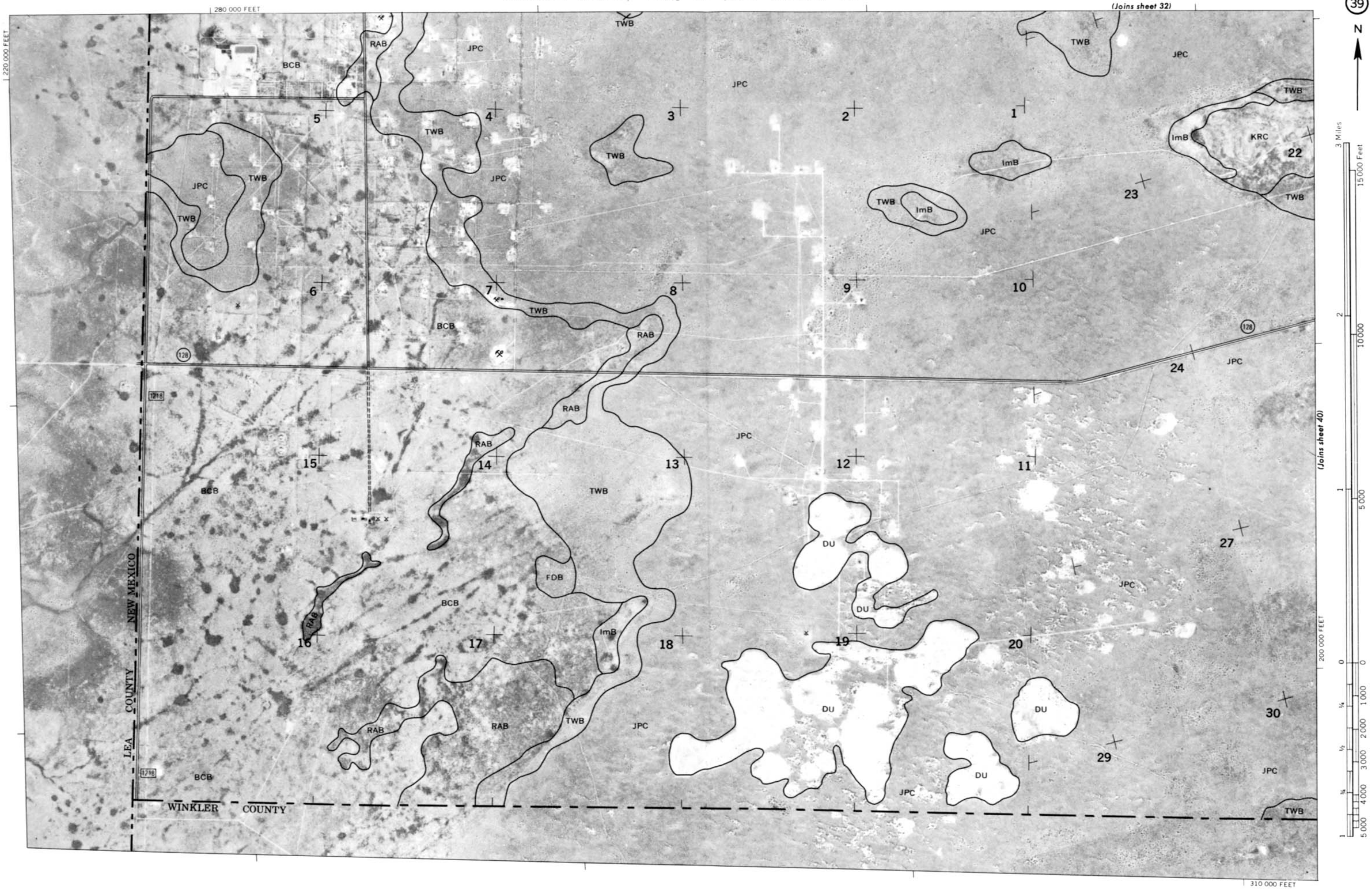
Land division corners are approximately positioned on this map

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 38

ANDREWS COUNTY, TEXAS — SHEET NUMBER 39

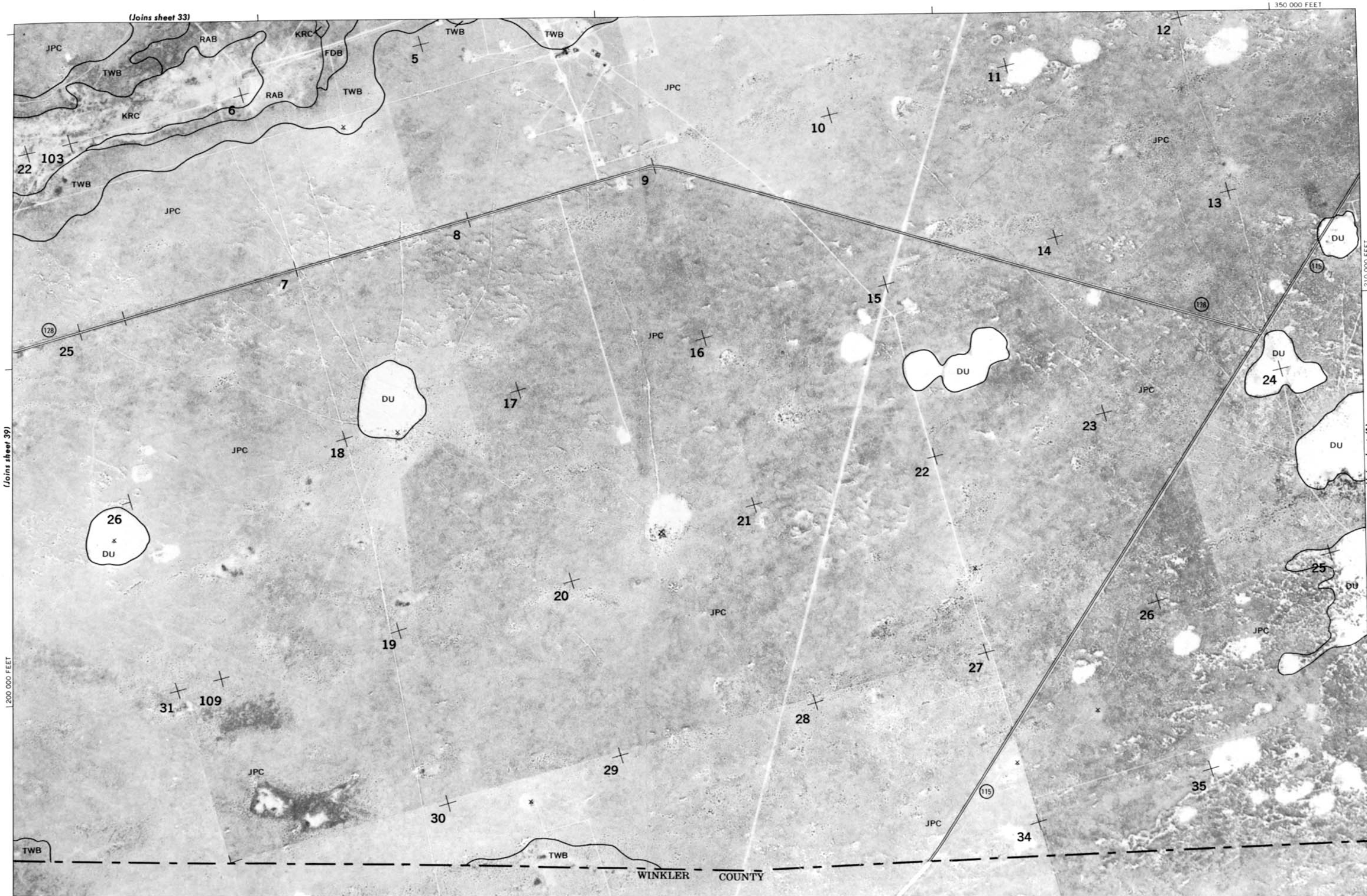


ANDREWS COUNTY, TEXAS NO. 39

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

(40)

ANDREWS COUNTY, TEXAS — SHEET NUMBER 40



N

Scale 1:31680

3 Miles 2 1 0 ¼ ½ ¾ 1

15000 Feet 10000 5000 0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

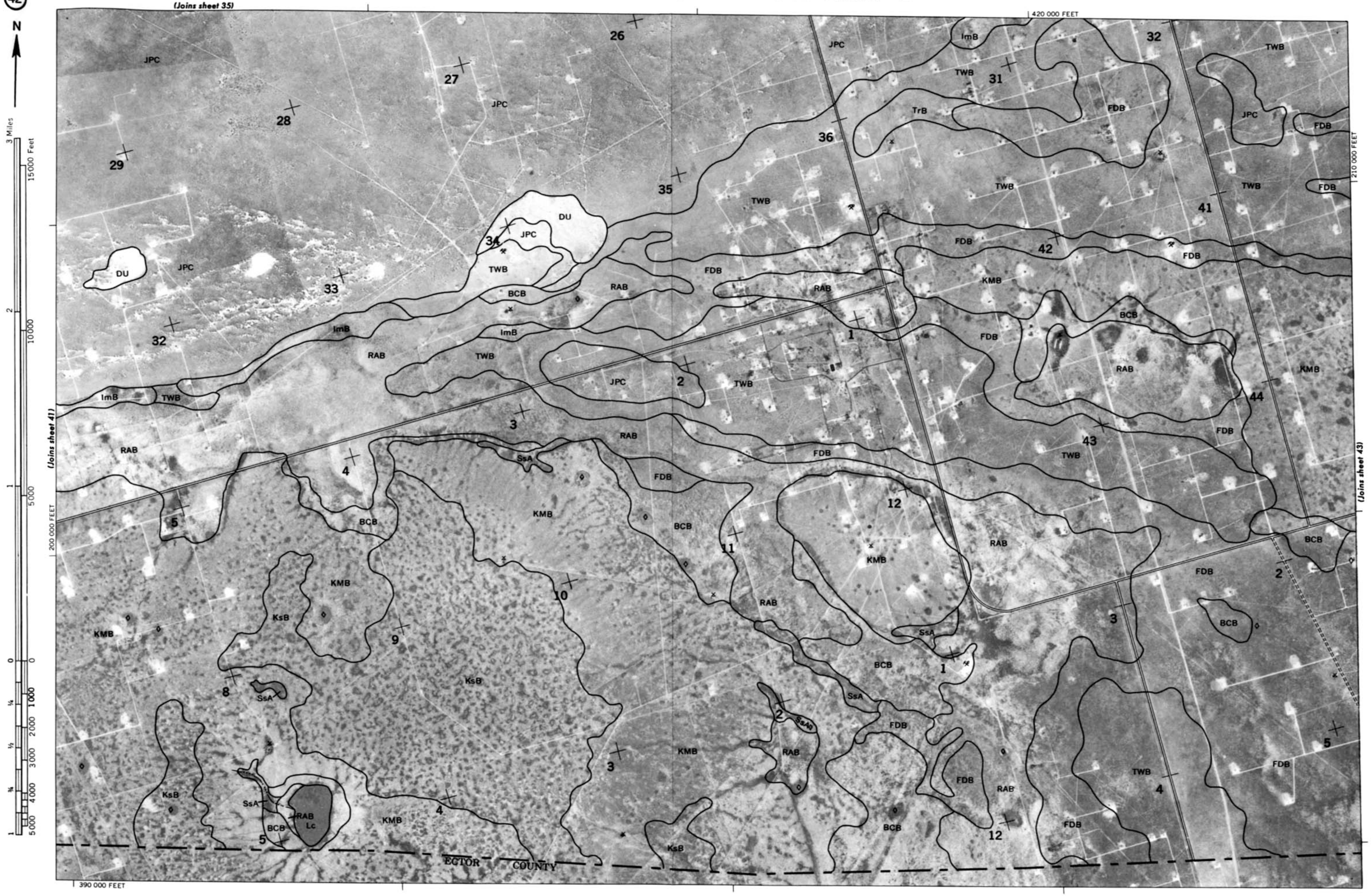
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS NO. 40

ANDREWS COUNTY, TEXAS NO. 41

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 42



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

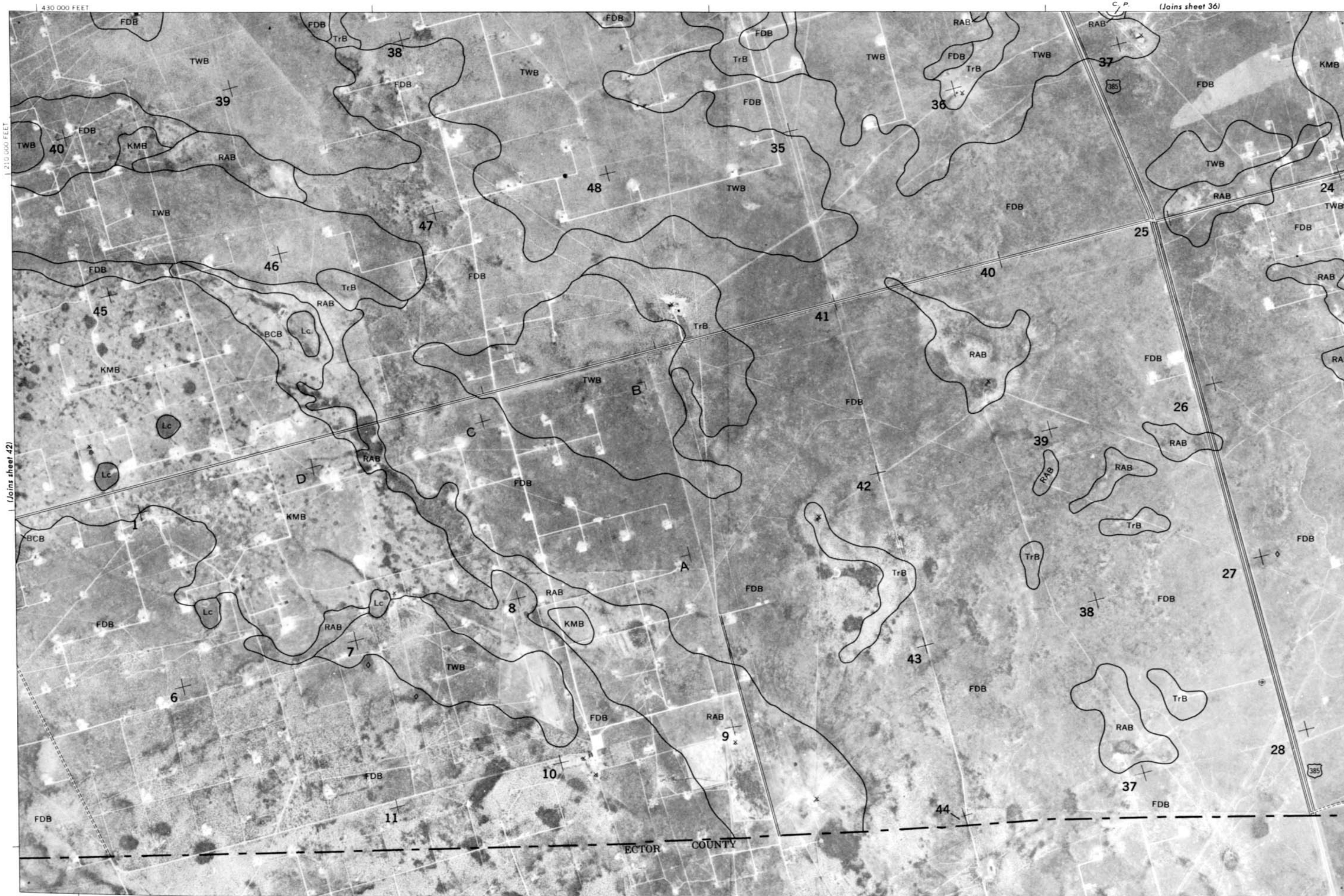
ANDREWS COUNTY, TEXAS NO. 42

ANDREWS COUNTY, TEXAS — SHEET NUMBER 43

43

ANDREWS COUNTY, TEXAS NO. 43

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone
Land division corners are approximately positioned on this map.



N

Scale 1:31680

Miles	Feet
3	15000
2	10000
1	5000
0	0
¼	1000
½	2000
¾	3000
1	4000
	5000

Land division corners are approximately positioned on this map.

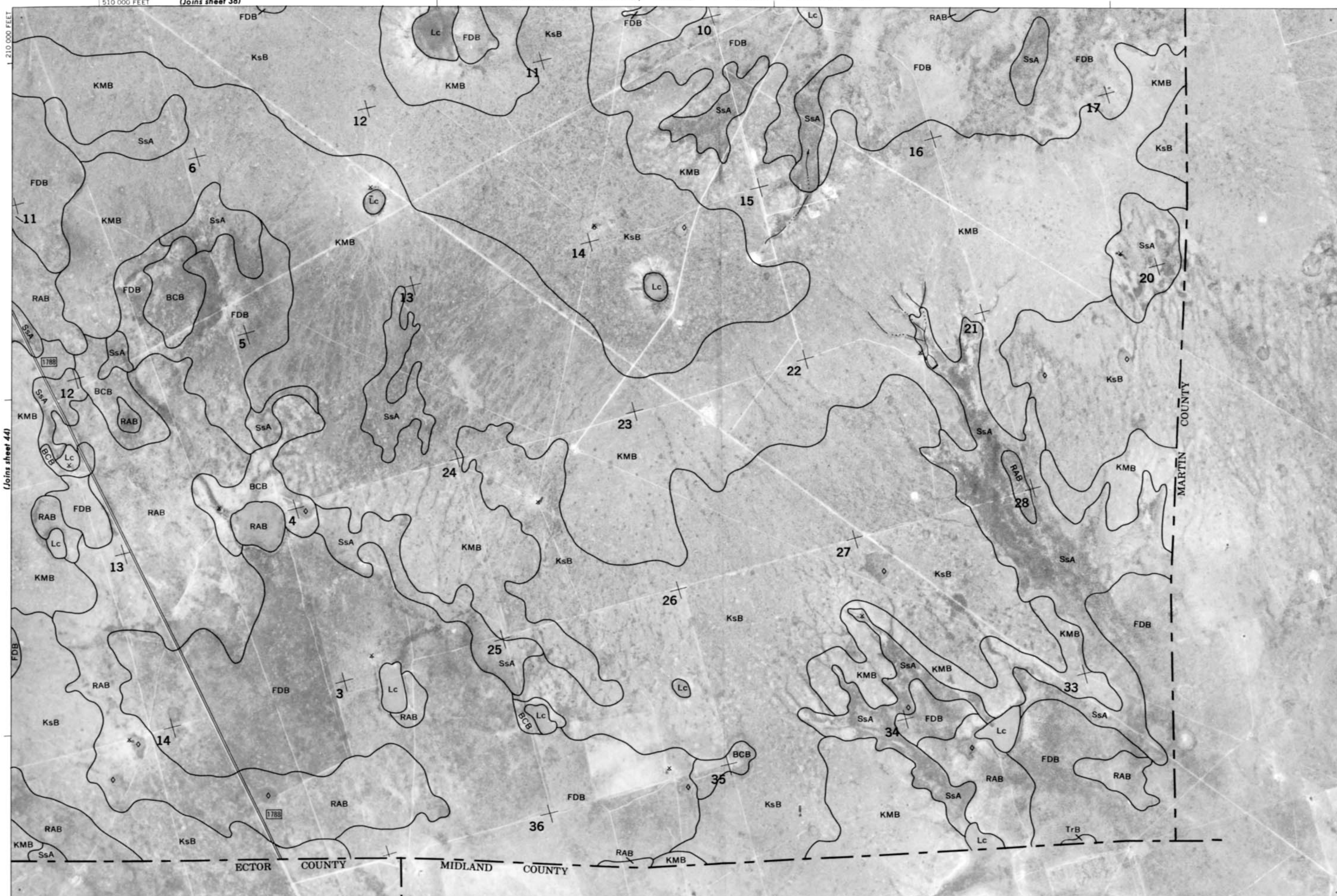
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.

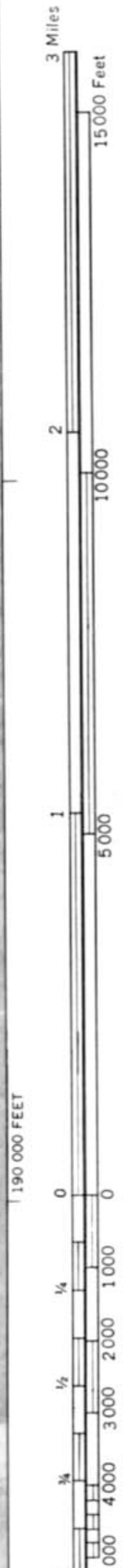
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.

ANDREWS COUNTY, TEXAS — SHEET NUMBER 45

45

N





ANDREWS COUNTY, TEXAS NO. 45

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Texas Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the Texas coordinate system, north central zone.
Land division corners are approximately positioned on this map.